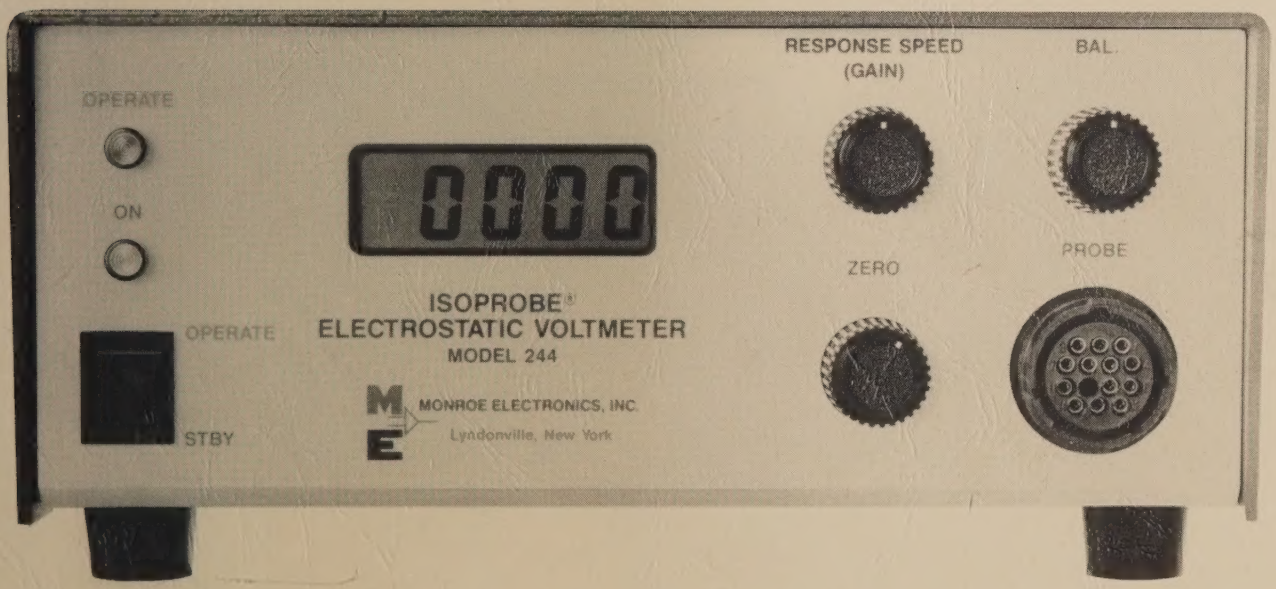
JUN
91

INSTRUCTION MANUAL

ISOPROBE® ELECTROSTATIC VOLTMETER

MODEL 244A



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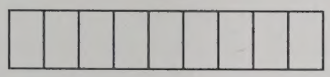
SERIES



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MODEL 244A

ISOPROBE® ELECTROSTATIC VOLTMETER

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REVISION NOTES: MODEL 244AK -- ÷200 OUTPUT

BEWARE - - HIGH VOLTAGE

GENERAL:

Monroe Electronics ISOPROBE® instruments are non- contacting voltage followers.
This means an instrument indicating 1500 volts has its probe operating at 1500 volts off ground.

If it is accidentally touched, the probe will apply VERY BRIEFLY 1500 volts to the unwary participant.

Typically, a spark will jump which will be disturbing but not hazardous electrically. (but you could recoil from the surprise and hurt yourself.)

SHORT CIRCUIT CURRENT:

The short circuit current that can be delivered by an ISOPROBE® voltmeter is limited to approximately 500 μA which is below the threshold of feeling for most people and therefore is clearly no hazard.

STORED ENERGY:

The high voltage spark is caused by the discharge of the capacitance of the system through the body. This stored energy is typically in the order of a few millijoules while the lethal level of stored energy has been approximated at 27 joules.

A safety factor of better than 1000:1 therefore exists.

ALTHOUGH THE SPARK IS CLEARLY ANNOYING, IT WON'T HARM YOU UNLESS YOU OVERREACT.

MONROE ELECTRONICS, INC.
LYNDONVILLE, NEW YORK 14098
DECEMBER, 1975

SECTION 1

SPECIFICATIONS

A. APPLICATIONS:

The Model 244A instrument permits accurate voltage measurements of electrostatic or other high impedance sources without physical contact. It utilizes an electrostatic chopper for low drift, and negative feedback for accuracy and probe-to-surface spacing insensitivity.

B. FEATURES:

- Integrated Solid State Circuitry
- Good Accuracy
  Stability
  Reliability
- Easy Maintenance
- ±3kV Input Range
- Fast Speed-of-Response
- Specified AC Performance
- Low Noise
- Digital Liquid Crystal Display
- HV/1000 Recorder Output
- Connectable for unlimited multiple channel operation

C. RANGE:

0 to ±3000 volts DC.

D. STATIC ACCURACY:

The recorder output accuracy referred to the input is better than 0.10% of reading or 0.1V whichever is greater. (Probe- to-surface spacing .020", 0.5mm).

E. SPEED-OF-RESPONSE:

10-90% probe-to-surface spacing .040" (1.02mm), gain adjusted for critical damping.

Speed of Response

	typ.	max.
1kV Step	1.5 msec	2.5 msec
2kV Step	2.0 msec	3.5 msec
3kV Step	3.0 msec	4.5 msec

F. SETTLING TIME:

typical 3.5msec. 0-99% 1kV step, 040"(1.02mm) gain adjusted for critical damping.

15 msec. 0-99.9% 1kV step, .040"(1.02mm)

G. FREQUENCY RESPONSE:

Small signal bandwidth is related to amplitude. At 115 volts RMS bandwidth is typically -3db at 300 Hz.

H. DRIFT:

Drift is specified with 1017S or E probes at .005" (.13mm) probe-to-surface spacing, purged in a clean stable atmosphere.

1. Less than 0.01V/hr. non-cumulative after 1 hr. warm-up in an uncontaminated atmosphere.

2. Indiscernible effects of line voltage variations, 10 to 90% relative humidity, 15°C to 35°C temperature range.

I. NOISE (Referred to Input):

Probe-to-surface spacing = .005" (.13mm), 1017S or E probe 600 mV RMS or 2V p-p wideband typical. See graphs for other aperture or probe-to-surface spacings. Also check individual probe specifications.

J. SURFACE RESOLUTION:

Surface resolution is dependent upon probe aperture size and probe-to-surface spacing. Refer to probe literature for specific information relative to probe being used.

K. PROBE-TO-SURFACE SPACING ERRORS:

Independent balance and zero adjustments allow voltage readings independent of probe-to-surface spacing. The stability of these adjustments relates to the same factors as does drift.

L. METER:

Four digit auto-zero, auto-symmetry, auto-polarity meter, with a back-lit liquid crystal readout.

M. RECORDER OUTPUT:

A low voltage HV/1000 output is provided with a 3V max. output. The output is capable of driving 1000Ω or greater.

N. POWER INPUT:

100, 117 or 230 volts ±10%, 50/60 Hz., 15 watts max.

O. PROBE DIMENSIONS:

Model 1017 series probes are 0.35" (8.9mm) x .35" (8.9mm) x 2.85" (72.4mm); weight 6¼ oz. (180 gm).

P. SIZE AND WEIGHT):

Size 4" (10.2cm) high x 8½" (21.6cm) wide x 15" (38.1 cm) deep. Weight 7 lbs. 3 oz. (3.26kg.).

SECTION 2

INSTALLATION

CAUTION:

Before plugging instrument in, make certain that it is matched to local power line voltage. The factory set line voltage is indicated on a label directly below the power connector and in the small window in the fuse drawer.

In the event that it is desired to change the operating voltage of the instrument (or inspect or replace the fuses), squeeze the tab on the drawer and remove the drawer. Slide the square insert out of the drawer, replace the fuse with the correct value and orient the insert so that the desired line voltage shows through the window. Replace the drawer in the power connector. CHANGE THE LABEL TO CORRESPOND. All units are shipped wired for 115 VAC unless otherwise specified.

NOTE:

Wire Color Code For Line Cord Provided.

HIGH SIDE OF LINE - BLACK or BROWN

LOW SIDE OF LINE - WHITE or LIGHT BLUE

SAFETY GROUND - GREEN or GREEN/YELLOW

A. PROBE PURGING:

Probe purging improves instrument performance especially with regard to zero stability, noise and sensitivity to variations in probe-to-surface spacing. Optional Model 1017/22G purge kit available from Monroe Electronics maintains an even air flow, reduces temperature variations and filters out dust and other particles.

Contact potential is a function of these variables and should be considered when making any changes in the purging techniques. Care should be taken to maintain the purged air as free from chemical vapor contamination as possible.

Probes may also be purged using clean, dry oil-free air from a local source or through the use of dry nitrogen or other inert gas. Pressure needs only be sufficient to maintain a positive flow of gas out of the sensitive aperture to prevent foreign materials from entering and, in no case should it exceed ½ psi (14" w.c.). All materials used should have low out-gassing properties.

For best results, leave purge in continuous operation. For long term storage, cover the end of the probe with the plastic cap supplied or with aluminum foil to seal against contamination.

B. MOUNTING:

The 1017 and all other compatible probes must be mounted with the sensitive aperture facing the surface to be measured.

The probe must be electrically isolated for up to 3400V, since the probe acquires the potential of the surface being measured.

Further probe mounting information is given in Appendix I.

C. PROBE-TO-SURFACE SPACING:

CAUTION:

When operating at probe-to-surface spacing of less than 0.125 inches (3mm) -- BEWARE OF PROBE-TO-SURFACE ARC-OVER.

Air is subject to dielectric breakdown when the probe-to- surface spacing is low and the surface voltage is high. A destructive arc-over can occur damaging the surface under test and/or the sensitive circuitry of the probe.

REFER TO FIGURE 2-1 TO DETERMINE THE SAFE PROBE-TO-SURFACE SPACING FOR A GIVEN UNKNOWN VOLTAGE.

Probe to surface spacing should be maintained as close as physically reasonable for best performance. Typical spacing range is from .005" (0.1mm) for unknown voltages below 500 volts to over .125" (3mm) for unknown voltages up to 3000 volts.

As probe to surface spacing increases instrument performance will suffer:

1. Decreased Accuracy
2. Decreased Speed-of-Response
3. Decreased Surface Resolution
4. Increased Noise
5. Increased Drift

D. SYSTEM GROUNDING:

The instrument is normally grounded via power cord and the potential measured is referenced to ground. A rear panel ground connection is provided.

E. OUTPUT CIRCUITRY:

The output connector is a BNC connector mounted to the rear panel. The output voltage is the measured voltage divided by 1000. Range is ±3V.

ARC BREAKDOWN VS. PROBE-TO-SURFACE SPACING

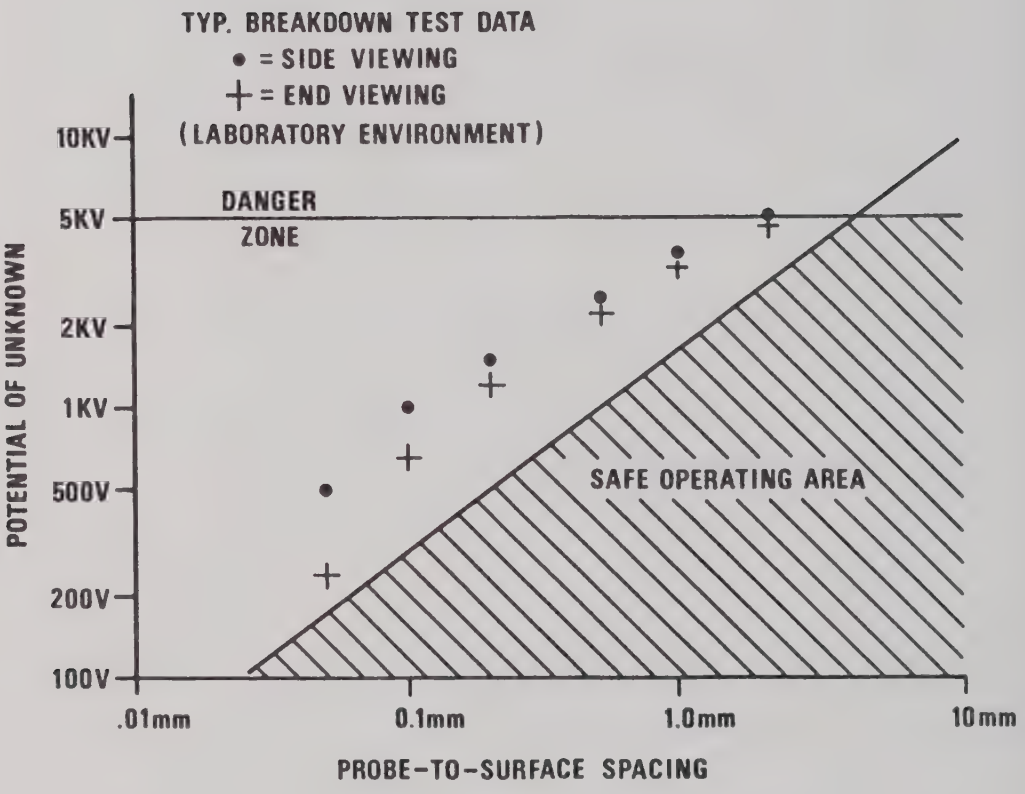


FIGURE 2-1

F. REMOTE CONTROL (SLAVE CONTROL):

Provision is made for remote operation via J204 located on the rear panel.

External connections can be made as follows:

1. Parallel connect the inner and outer connection of the slave plugs of all units.

2. Connect any solid state switch or relay capable of switching 30V DC and sinking n x 10 mA DC, where n is the number of units to be controlled.

NOTE: Low side of switch must be system GRD.

3. A remote operate light may be connected as indicated on 244A-2/1 schematic.

G. MULTIPLE-UNIT, MASTER/SLAVE CONNECTION:

The 244A is designed to facilitate control of the standby/operate mode of slave units by a master unit.

External connections are made as follows:

1. Connect all slave units (units to be controlled) as indicated in Section F.

2. Terminate the center conductor of the slave plug to the center conductor of the master, and outer conductor with the outer connection.

SECTION 3

CONTROLS AND INDICATORS

FRONT PANEL CONTROLS - FIG. 3-1

A. STANDBY/OPERATE SWITCH:

Controls the operating condition of the unit.

1. STANDBY - Starts the probe oscillating, but leaves the H.V. disabled, unless activated by the remote (rear "slave") connector.

2. OPERATE - Turns on the H.V. supplies, only if the probe is plugged in and the fork is oscillating. This position overrides the remote control.

B. ON INDICATOR:

Indicates that the low voltage supplies are on and operational status is controllable by remote operation.

C. OPERATE INDICATOR:

Indicates that the H.V. is on and that the probe housing may be at any voltage up to ±3400V. Excessive gain or excessive loading on the probe such as probe contact to a grounded surface, causes the operate light to blink, indicating a malfunction.

D. BALANCE:

Balances internal probe contact potential to obtain probe to surface spacing insensitivity. This adjustment procedure is described in Section 4B (may also be used for large zero offset when spacing insensitivity is not needed).

E. ZERO:

Compensates for unwanted offsets in the range of ±4 volts. This does not affect probe-to-surface spacing sensitivity.

F. RESPONSE SPEED (GAIN):

Adjusts system speed-of-response, static accuracy and stability by varying open-loop system gain. Excessive gain causes system instability and degradation in static error. Insufficient gain produces static error and slow speed-of- response. System gain and responses vary with probe-to- surface spacing and must be compensated by adjustment of this control.

G. PROBE CONNECTOR:

Connector for attachment of 1017 and 1015 probes. The connector is interlocked with the operate switch and will shut down the high voltage section when probe is disconnected.

NOTE: A special shortened pin is used in P201 (on probe) for safety purposes in other instruments in the ISOPROBE® Series.

REAR PANEL CONTROLS - Fig. 3-2

H. RECORDER OUTPUT:

Output is 0V ± 3V for full scale. A BNC connector is provided on the rear panel. The output voltage is equal to the voltage measured divided by 1000. Minimum load resistance is 1k ohm.

I. MASTER JACK:

Allows other units with slave connections to be operated by this unit. The output provides a switch closure when the front panel standby/operate switch is in the OPERATE position.

J. SLAVE JACK:

Input for remote enable/disable of the high voltage section. In STANDBY a closure between the center and outer conductors of the plug will enable the high voltage if the probe is attached and the fork oscillating. The remote can be overridden by switching the front panel switch to either OPERATE or OFF. The switch should be capable of handling 30V open and n x 10mA, where n is the number of units being controlled.

K. POWER ON/OFF SWITCH:

Main power to instrument is on when red ring is visible on side of rocker.

L. GROUND JACK:

5 way binding post connected to power line ground to provide system ground.

M. FUSE DRAWER:

Contains fuses and line voltage switching selector insert. See "CAUTION", Page 4.

N. LIGHT CONTROL:

Sets intensity of meter backlighting.

FIG. 3-1
FRONT PANEL

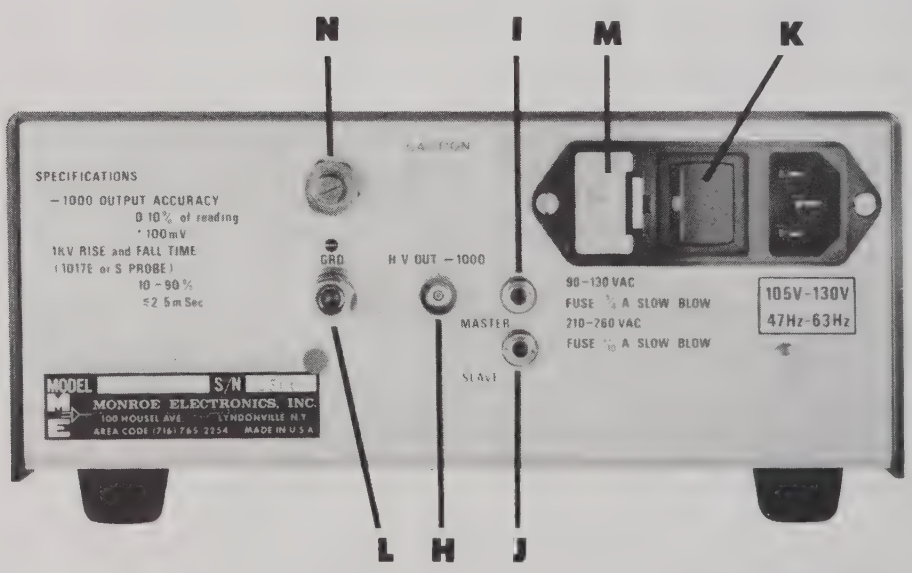


FIG. 3-2
REAR PANEL

SECTION 4

OPERATION

CAUTION:

Verify that instrument operating voltage matches local power line voltage. See Section 2.

PRECAUTIONARY NOTE

Model 244A is a non-contacting voltmeter. The potential of the probe will attempt to follow the potential of any object within the field of view of the sensitive electrode (up to ±3400 volts) when the instrument is operating. In the interest of operator safety and also to reduce high voltage stress within the instrument, it should be left in the STANDBY mode whenever it is not being used and particularly when the probe will not be "looking" at a surface of less than 3000V.

A. INITIAL SET-UP:

1. With PROBE mounted as previously described in Section 2, connect probe plug to the probe receptacle on the instrument front panel.

2. Switch STANDBY/OPERATE switch to OPERATE.

3. Set RESPONSE SPEED (GAIN) control according to the probe-to-surface spacing and desired speed-of-response. In the event the front panel meter is the sole indicator of the instrument output, the normal static error is very small and speed-of-response is non- critical. For 1/8" (3mm) spacing, set at ½ of CW rotation.

NOTE:

Decreasing the probe-to-surface spacing has the same influence as increasing the GAIN control. The GAIN control should, therefore, be re-adjusted whenever the probe-to-surface spacing is altered if optimum speed-of-response is desired.

a. Connect a DC supply through a switch to a metal plate at the same probe-to-surface spacing to be utilized (preferably the same surface if practicable) as shown in FIGURE 4-1.

NOTE:

Monroe Electronics, Inc., Model 241 ±3kV Reference Supply, if available, may be used to drive the plate directly, eliminating the need for switch and high voltage probe and producing a clean, bounce-free repetitive step. The supply has an oscilloscope sync. output.

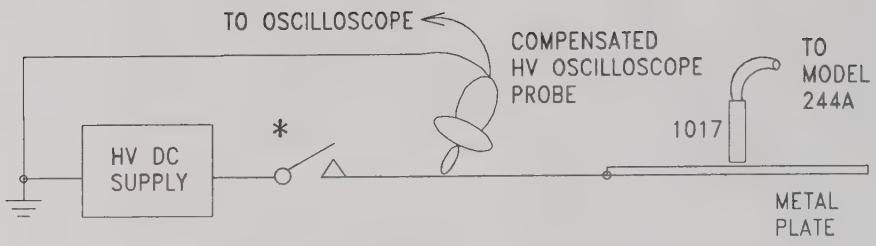


FIGURE 4-1

* Switch with low contact bounce - preferably H.V. Reed Relay Contact

b. Connect the OUTPUT to a recorder or scope.

c. While closing the switch, observe the instrument output and adjust GAIN for fastest speed-of-response with minimum overshoot in step response.

Once properly adjusted, the GAIN control should require no further attention unless the probe-to-surface spacing is altered.

The static follow-up error (difference in DC potential between the unknown and the probe) of a carefully zeroed and adjusted instrument is typically less than 0.05% throughout its range.

d. With the probe aperture viewing a zero volt (or grounded) surface, set ZERO control at mid-range. Adjust BAL (balance) control for near zero reading.

B. SPACING INSENSITIVITY OVER LARGE PROBE-TO-SURFACE SPACING RANGE:

This adjustment procedure will minimize offset errors due to variations in probe-to-surface spacing. This adjustment is preferably done with a mechanical positioning device and a grounded plate.

1. Position probe for minimum probe-to-surface spacing.

2. Adjust for a meter reading of zero, as described in Sect. A3d above.

3. Re-position to maximum probe-to-surface spacing and adjust BAL control for a meter reading of zero.

4. Return to the minimum spacing and re-adjust ZERO. Repeat this procedure until the degree of spacing insensitivity desired is reached. The stability of this adjustment is directly related to zero drift and the probe-to-surface spacing.

SECTION 5

THEORY

A. GENERAL: Principle of Operation (See Figure 5-1)

The electrostatic electrode "looks" at the surface under measurement through a small hole at the base of the probe assembly. The chopped A.C. signal induced on this electrode is proportional to the differential voltage between the surface under measurement and the probe assembly. Its phase is dictated by the D.C. polarity.

The reference voltage and this mechanically modulated signal, conditioned by the high input impedance preamplifier and signal amplifier are fed to a phase sensitive detector whose output D.C. amplitude and polarity are dictated by the amplitude and phase of the electrostatically induced signal relative to the reference signal. The output of the phase sensitive detector feeds a D.C. integrating amplifier. Its output polarity is inverted to that of the unknown. The output of this amplifier is used to drive a H.V. amplifier (AV = -300) which in turn drives the probe to the same potential as that of the surface under measurement.

The probe is driven to a D.C. voltage typically within 0.1% of the potential of the unknown for a .040" probe-to-surface spacing. By simply metering the output of the H.V. amplifier, one has an accurate indication of the unknown potential.

B. NULL BALANCE:

This instrument's basic operating principle, i.e., "field-nulling" provides a high degree of immunity to errors in measurement caused by variations in probe-to-surface separation,. (As long as the probe and the surface under measurement are at the same potential the electrical field between them is zero, neglecting fringing, regardless of the probe-to-surface distance.)

If, however there exist voltage sources in the vicinity of the sensitive electrode which are independent of the unknown to be measured, the offsets produced will detrimentally affect the spacing independence. Such voltage sources include contact potential differences among the internal probes parts, small specks of charged dust particles, etc.

The null balance circuitry is provided to neutralize such offsets by applying a voltage directly to the sensitive electrode.

C. ZERO:

The instrument's zero control is a voltage source connected in the metering circuitry. It is used to overcome offsets produced by voltage sources external to the probe.

D. GAIN:

The instrument functions as a closed loop unity gain voltage follower. Its open loop gain from probe to integrator is determined by the gain of various amplifiers. The exact gain required for optimum transient responses during a specific measurement is determined by the probe-to-surface spacing used. In order to accommodate measurements at various probe-to-surface spacings, a front panel gain control is provided which controls the gain of the signal amplifier.

7. Connect pulse source (M.E. Model 241 or equiv.) set to zero volts out to this plate (Surface-Under-Test or "SUT"). Be sure to connect source's ground return to Model 244A ground, a five-way binding post located on the rear panel.

10. Temporarily install a jumper wire between chassis ground and circuit common which is point "V" on 3216B-2 (mother board).

11. With power switch in the OFF position, connect the Model 244A to the appropriate source of power.

12. Set power switch to STANDBY position. The green "ON" indicator should light and the LCD meter should display four digits.

13. Adjust meter back-lighting to a suitable level using the rear-panel lighting control.

D. LOW VOLTAGE POWER SUPPLY CHECK:

NOTE: ALL VOLTAGES AND SIGNAL CHECKS ARE TO BE WITH RESPECT TO THE REAR PANEL GROUND JACK UNLESS OTHERWISE NOTED.

1. * Set variable power source to minimum line voltage (10% below nominal line voltage).

2. Check the following voltages and noise levels:

TEST POINT	DC VOLTAGE	NOISE
"SS"	+15VDC ±0.5V	<1mV.p-p, 120Hz
"UU"	-15VDC ±0.5V	<1mV.p-p, 120Hz
TP-7	+15VDC ±1.5V	<5mV.p-p, 120Hz <100mV.p-p, 100kHz
L3	+15VDC +1.4V, -0.5V	
L4	-15VDC +0.5V, -1.4V	
"EE"	+12VDC ±).25V	
"GG"	-12VDC ±0.70V	

3. If any of these voltages or noise levels are incorrect, correct before proceeding.

E. OSCILLATOR AMPLITUDE ADJUSTMENT:

1. Connect oscilloscope (1V/div.) to terminal "T" (orange wire) on motherboard. The oscillator drive output will be displayed.

2. Adjust R-81 for a 6Vp-p sine wave. No distortion or clipping should be observed.

F. DEMODULATOR ZERO:

1. Turn power off.
2. Connect oscilloscope to the end of R-47 closest to the front panel.
3. Remove PC-1 (photocoupler) from 3216B-2 motherboard.
4. Switch power switch to STANDBY.
5. Adjust R-50 for minimum peak-to-peak voltage with scope set to 1mV./div. range.
6. Turn power off.
7. Replace PC-1.

G. PHASE ADJUSTMENT: (Make this adjustment only with a 1017S or 1017E probe.)

1. Switch power switch to STANDBY. (Oscilloscope still connected to R-47 as above.)
2. Using BALANCE control on front panel, adjust oscilloscope presentation for best null.
3. Apply +10 volts to test plate (SUT).
4. Adjust R-89 for best representation of an ideal half-wave rectified sine wave.
5. Apply -10 volts to SUT and check waveform. If necessary, adjust R-89 for best compromise. Remove voltage from SUT.
6. Remove oscilloscope probe and jumper (installed in 6-C-9).

H. INTEGRATOR ZERO:

1. Connect oscilloscope to A7, pin 8.
2. Switch unit under test (UUT) to OPERATE. OPERATE light should come on. If light blinks, reduce GAIN until it remains on.
3. Adjust BALANCE for a display of zero volts.
4. Reduce system gain (GAIN) until display begins to indicate drift (a continued upward change) then increase gain until reading returns to zero.

mental frequency as observed on oscilloscope (1kHz. for 1017 probe; 700 Hz. for 1009 or 1015).

6. Switch UUT to STANDBY and remove oscilloscope probe from A-7.

I. * HIGH VOLTAGE REGULATOR ADJUSTMENT:

NOTE:

The four small potentiometers located on the HV module PC boards set PFET and NFET bias levels. They are factory preset before encapsulation and should not be adjusted in the field.

1. Adjust front panel ZERO for an indication of "0000" on the front panel DPM.

2. Turn power off.

3. Locate A-7, TP-9, "SS", "UU" and R-8. Viewed from the front of the instrument, A-7 is on the left side of the motherboard about halfway back. TP-9 is about 1½" to the right of A-7. "SS" and "UU" are just in front of the power transformer and have red and violet wires attached to them, respectively. R-8 is a potentiometer centered on the board near the back panel.

4. Remove A-7.

5. Connect a jumper wire (clip lead) between TP-9 and "SS".

6. Apply power and switch UUT to OPERATE.

CAUTION:

High voltage will be present on the probe and sections of the board operating at circuit common.

7. Adjust R-8 for an indication of -3400 volts on the front panel DPM.

8. Move jumper wire from "SS" to "UU". Check front panel DPM for an indication of +3400 volts, ±50 volts.

9. Turn power off.

10. Remove jumper wire.

11. Replace A-7.

J. * NOISE ADJUSTMENT:

1. Attach 1000:1 high voltage oscilloscope probe to high voltage output (terminal "V"). Set oscilloscope controls to 0.1 mV./division (vertical) and 20μS/division (horizontal).

2. With bottom plate and HV shield in place, switch unit to OPERATE and adjust C-5 for minimum 25kHz. peak-to-peak noise. If the peak-to-peak noise amplitude cannot be adjusted below 50mV. (referred to output), R-4 must be re-selected so that the square wave has minimal tilt and C-5 then re-adjusted.

K. SPEED-OF-RESPONSE:

NOTE:

This test is a valuable indicator of overall system performance. Deviations from the norm point to need for service or further adjustment to optimize critical areas covered thus far.

R-25 (GAIN +) and R-23 (GAIN-) are to be adjusted in conjunction with front panel GAIN control during speed-of-response check. Criteria for proper adjustment are that the instrument make specified speed-of-response and full output without oscillation. R-25 and R-23 are located on the motherboard behind the probe connector.

1. Fix probe-to-surface (SUT) spacing of 1/8" (0.32cm.).

2. Set GAIN to approximately ¼ of clockwise rotation.

3. Connect oscilloscope to HV OUT/1000 output connector (on rear panel).

4. Switch UUT to OPERATE.

5. Pulse SUT to +1kV (repetitively).

6. Adjust GAIN and oscilloscope controls until a critically damped step response between 0% and 100% is observed. Rise (and fall) time from 10% to 90% should be less than 2.5 milliseconds.

7. Repeat for +2kV. Response time (10% to 90%) should be less than 3.5 milliseconds.

8. Repeat for +3kV. Response time should be less than 4.0 milliseconds.

9. Check response to negative steps in a similar manner.

L. * FOLLOWER ACCURACY

CAUTION:

This test requires the use of a high-impedance voltmeter or multimeter (capable of being "floated" to ±3kV off of "ground" ie, it must be self-contained and not connected to the power line). The input must be adequately protected against high voltage as the test can be quite abusive to instrumentation.

1. Connect this meter between the test plate (SUT) and circuit common (terminal "V").

2. Set meter to 6 volt DC range.

3. Switch UUT to OPERATE.

4. Adjust BALANCE control for center-scale indication.

5. Apply ±1kV, ±2kV and ±3kV to the SUT, respectively. Follower accuracy (indicated on meter) should be within ±0.1% of the applied voltage.

M. NOISE CHECK:

1. Set probe-to-surface spacing to 0.005" (0.013cm.).

2. Set GAIN to approximately ¼ of clockwise rotation.

3. Connect HV OUT/1000 output to oscilloscope.

4. Switch UUT to OPERATE.

5. Pulse SUT with +300 volt pulses.

6. Adjust GAIN and oscilloscope controls for critically damped transient response.

7. Remove pulse source and ground SUT to chassis.

8. Disconnect oscilloscope and replace with RMS voltmeter. Noise is typically 0.3 to 0.6 mV. rms.

N. * INTEGRATOR GAIN:

This adjustment varies the slew limitations of the unit, making 10% to 90% response times faster but increasing the settling times to 1%. Consult factory for adjustment procedure.

O. HV OUT/1000 OUTPUT AND METER CALIBRATION:

1. Connect HV OUT/1000 output to DVM.

2. Adjust BALANCE and ZERO for an indication of zero volts (polarity sign indecision) on DVM and front panel meter.

3. Apply +3000.0 volts to SUT.

4. DVM (at output) should indicate +3.000 volts ±0.1%. Adjust R-16 (accessible through a hole in the brass shield near the center of the instrument) if necessary to meet this condition.

5. Front panel meter should indicate +3000 ±1 LSD. Adjust R-7 on 3218 board if necessary.

6. Apply -3000.0 volts to SUT and repeat steps 4 & 5 for best compromise

7. Check calibration at ±2kV and ±1kV.

8. Remove test equipment, replace cover -- this completes adjustment procedure.

SECTION 7

TROUBLESHOOTING

A. GENERAL:

The Model 244A has most of the signal processing circuitry ground referenced. This allows trouble-shooting the system in a closed loop (normal operating) condition.

Related waveforms and applicable D.C. voltages and noise levels are indicated on 244A-2/1, 244A-2/2 and 244A-2/3 schematics.

BEFORE ATTEMPTING TROUBLE-SHOOTING TECHNIQUES, CONSIDER THE FOLLOWING:

1. Attempt to determine mode and cause of failure. If you broke it you probably have some idea how. If someone else did, try to get as many details as possible.

2. Check control settings. Review the CONTROLS and INDICATORS section of this manual.

3. Check power line voltage. Be sure that VOLTAGE SELECTOR is in the correct position. Check fuse.

4. Look for obvious physical damage (charred parts, loose connections, broken solder joints, broken circuit board, etc.)

5. Check calibration. If it appears that the instrument is uncalibrated, review the ADJUSTMENT section of this manual.

6. Always rectify the cause of the problem.

B. INITIAL-SET-UP:

Prepare 244A and probe as for normal operation with probe in an insulated fixture with the sensitive aperture looking at a grounded plate having a probe-to-surface spacing of approximately 3mm (1/8").

C. LOW VOLTAGE POWER SUPPLIES:

1. With 244A OFF, connect a jumper wire from ground jack on rear panel to V (Floating common).

2. Connect low side of a DVM to ground jack on back panel and switch 244A to STANDBY.

3. Connect high side of DVM to the following test points:

LOCATION	DATA
SS	+15 ±0.5V.
UU	-15 ±0.5V.
TP-5	+12 ±0.25V.
TP-6	-12 ±0.70V.
TP-7	+15 ±0.75V.

D. OPEN LOOP CHECK:

1. REFERENCE SECTION

   a. With jumper connected as in C-1 above attach oscilloscope ground to rear panel ground post.

   b. Observe waveforms at points indicated below:

LOCATION	DATA
T (orange wire)	6Vp-p sine wave, <30 mVDC.
PC-2, pin 5	0 to +15v. square wave, 1kHz.
A-7 Pin 1	±2V DC.

2. SIGNAL SECTION

   a. Set front panel RESPONSE SPEED (GAIN) to fully CW position.

   b. Connect oscilloscope to A-6, pin 12. Adjust BAL. for minimum signal amplitude.

   c. Apply +100VDC to probe plate of (B) above.

   d. Waveform at A-6, pin 12 should be a sine wave at 1 kHz. and should be significantly greater than 10 mV.p-p. Reduce RESPONSE SPEED (GAIN) for 10mV.p-p (approx. mid-position).

   e. Check waveforms indicated below and on schematic 244-2/1.

LOCATION	DATA
A-6, pin 14	1.2V p-p, 1 kHz. sine wave
A-6, pin 8	60mV p-p, 1 kHz. sine wave
A-7, pin 8	800mV p-p to 2V p-p

NOTE: Actual amplitude is dependent upon gain of coupler PC-1. Waveform should

resemble waveform at A-6, pin 8.

A-7, pin 14	Half the p-p reading on A-7, pin 8 (see schematic).

f. Connect a jumper between TT and TP-8.

g. Connect oscilloscope to TP-9. With +100 VDC on probe plate TP-9 should be -12 to -14VDC. Changing plate potential to -100 VDC should change TP-9 to +12 to +14 VDC.

h. Any discrepancies found up to this point should be corrected before proceeding. Problems are generally in the immediate area of measurement, the semiconductor being most likely.

i. Remove jumper installed in (f).

j. Remove jumper between floating common (V) and rear ground post.

E. HIGH VOLTAGE AMPLIFIER:

The high voltage amplifier discussed here includes: the differential regulator, Model 3138 high voltage module and the high voltage amplifier section. This high voltage amplifier section shown on schematic 244A-2/1 includes: A-2, A-3, A-4 and associated components.

The input to this amplifier is the output of integrator A-7D and the output is taken between high voltage common and chassis ground.

WARNING

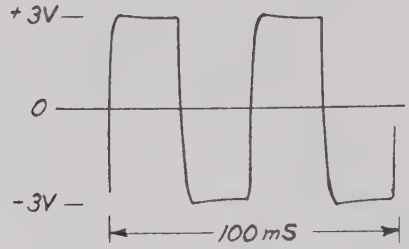
Voltages up to ±3400 volts may be present.

A $^{1}/_{1000}$ representation of the high voltage output may be taken at the output of A-2 (pin 6) if the entire amplifier is functioning. This allows observation with an oscilloscope even though a high voltage probe is not available as this output is only ±3.0 volts, ±5%.

A suitable procedure for evaluation of the entire H.V. amplifier is:

1. With power OFF, remove A-7.
2. Connect a 20 Hz., ±10 volt square wave source between TP-9 and chassis ground.
3. Connect oscilloscope between TP-10 and chassis ground.
4. Be sure probe connector is inserted.
5. Switch 244A to OPERATE.

6. The waveform at TP-10 should resemble that shown below (±3V, ±5% square wave inverted form of input). Total rise time in a properly operating HV amplifier is approximately 4ms for the 6kV step represented here:



F. HIGH VOLTAGE MODULE:

If this section is suspected, the simplest method of localizing the problem is by substitution of a known good high voltage module from another 244A-2. The module may be removed by extracting the three #6-32 screws from the inboard flange and lifting the high voltage module straight up. Inspect the circuitry inside for any obvious problems such as broken or burned components, loose connections and accumulated dust and dirt. Clean if necessary with compressed air.

In the event that no spare module is available, the following may be helpful:

To determine whether the H.V. Inverter is functioning, remove the outboard cover plate from the H.V. module. Hold an oscilloscope probe near (approximately 1 cm.) the two large disc ceramic capacitors (C-8 & C-9) and with the 244A-2 in the OPERATE mode watch for characteristic inverter hash.

CLOSED LOOP TROUBLESHOOTING CHART

SYMPTOM	POSSIBLE CAUSES
Drift (short term, 10's of volts in magnitude).	Defective probe. Test surface is not grounded back to instrument. Oscillator section. Signal sections.
Can't zero (and/or maintain spacing independence).	Dirty probe. Integrator zero.
Blows fuse in STANDBY.	Low voltage power supplies. Wrong line voltage.
Blows fuse in OPERATE.	H.V. Amplifier. System oscillation. H.V. Preregulator.
Erratic random spikes in recorder output.	Corona breakdown in H.V. module.
120 Hz. ripple in recorder output.	H.V. preregulator. Low Voltage Power Supply.
60 Hz.ripple in recorder output.	Ground loop in recorder or oscilloscope. Excessively strong 60 Hz. fields in measurement area.
Inaccurate reading in 1-3kV range.	Insufficient loop gain. Probe viewing partially grounded surface. Poor probe mounting. HV preregulator. HV amplifier.
Unit won't come out of OPERATE by remote control.	Remote interface. Probe oscillation detector. Probe oscillator.
Unit won't come out of OPERATE when probe is disconnected.	Same as above.
Excessive noise 1-2 kHz. or 25 to 50 kHz.	Phase adjustment, R-89. Integrator bandwidth adjustment. HV noise adjustment, C-5.
Recorder output accurate, DPM reading inaccurate.	DPM circuit.

Errors in one polarity only.	Integrator clamp (Q-4). HV Amplifier. HV Inverter. HV Amplifier. HV Preregulator.
Doesn't work with 1015 or 1009 probe but does with 1017 or conversely.	Phase adjuster.
Poor speed of response.	Defective probe. Signal path between probe and integrator. AC section of HV amplifier.

APPENDIX I

MODEL 1017 PROBE MOUNTING

The Monroe Electronics, Inc. Model 1017 Miniature Probe is intentionally constructed with no mounting devices as any such mounting device would serve only to enlarge the physical dimensions. It is, therefore, left to the user to devise a method of mounting the probe to suit his individual needs and to realize the fullest potential of the inherently small size.

As supplied, the probe is partially jacketed by a length of irradiated polyolefin shrinkable tubing. This jacket provides insulation of sufficient dielectric strength that the probe may be hand-held or clamped using light pressure for use within the operating range of the Model 244A ISOPROBE® Electrostatic Voltmeter.

This tubing is otherwise not essential to the operation of the probe. IT MAY BE REMOVED AND DISCARDED, IF DESIRED. It must, in fact, be removed if the probe is to be disassembled for any purpose such as cleaning (in those procedures involving removal of the case). A sharp model maker's knife may be used to slit the tubing using CAUTION to assure that the cable jacket is not nicked or slit.

If replacement is required, a $2^{5}/_{8}$ inch length of ALPHA FIT221-$^{3}/_{8}$ or equivalent is recommended. Apply heat only long enough to shrink the tubing in place as damage to the sensitive electronics and adhesives within the probe may result from prolonged elevated temperature on the outside of the case.

When devising fixturing for the Model 1017 probe, consideration must be given to the fact that the normal operating range of the Model 244A ISOPROBE® Electrostatic Voltmeter is ±3000 volts and that the probe assumes the potential of the surface under measurement within these limits. The probe, therefore, must be insulated from other parts of the system.

Choice of insulating materials, although not critical in many applications, should be limited, if possible, to "leaky" dielectric materials with relatively low volume resistivities (in the general order of 10^{10} ohm-cm) as opposed to those such as polystyrene which is a very good insulator. Example of "leaky" insulators are the phenolics. The primary purpose in this is to provide a discharge path for the insulator which has a short relaxation time. This is especially important in the vicinity of the sensitive aperture.

The Model 244A is capable of driving a capacitive load of several hundred picofarads without severe degradation in performance. It is possible, therefore, to attach the probe to some fixed portion of the apparatus via a metal clamp, so long as the metal clamp is insulated from the remainder of the apparatus.

In any friction clamp design, the pressure (unit force) on the probe case should be kept low, thus over as large an area of the case as possible as distortion of the gold plated brass may otherwise occur.

One possible configuration is illustrated in Figure A-I-1.

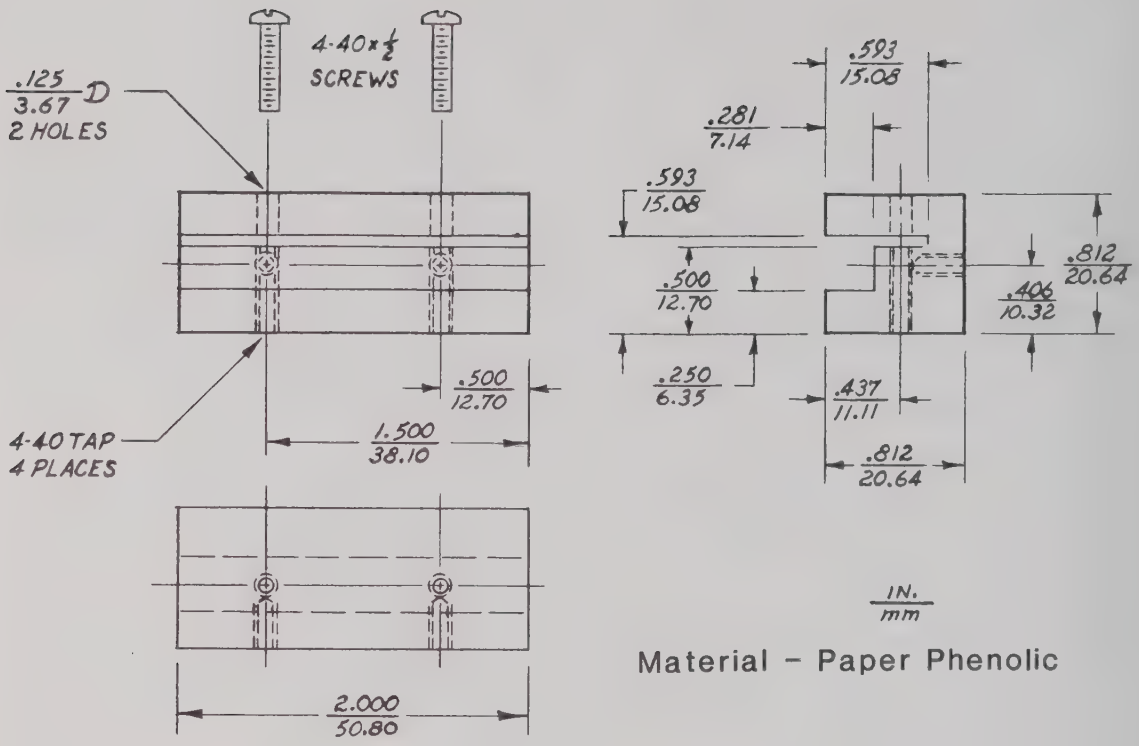


FIGURE A-I-1

For general bench use burette or utility clamps attached to a ringstand or similar support may prove adequate. These are available from scientific supply houses.

An attractive alternative to clamping is the use of double sided adhesive tape or fast-setting polymerizing adhesives such as LOCTITE* SuperBonder 495 cyanoacrylate adhesive or equivalent which does not require long setting or curing time and provides a relatively permanent bond. LOCTITE* is a registered trademark of and is available from:

*LOCTITE CORPORATION
Newington, CT 06111
(208)278-1280

APPENDIX II

10X GAIN MODIFICATION

(For use with high resolution probes)

Due to the smaller aperture in high resolution probes (1017EH, 1017SH, 1017EJ), electrostatic gain is lowered. As a result, it may not be possible to achieve optimized transient response except at extremely close spacing.

System gain may be increased approximately tenfold by replacing R28A (10K, in front corner of main PC board near meter) with a 1K, ¼W, 5% carbon composition resistor.

To replace resistor:

1. Remove cover and locate R28A.
2. Remove bottom panel from instrument (two #6-32 screws in center of side panel).
3. Carefully remove the two #6-32 screws which hold the front panel to the side rails (screws located just behind front feet) and move front panel so that it does not interfere with replacement.
4. Unsolder and replace resistor.
5. Re-assemble instrument.

After this change has been made, adjustment of front panel gain will be difficult at close probe-to-surface spacing when using standard probes. It is therefore suggested that units so modified be tagged in some manner to alert the unwary user.

APPENDIX III

MODEL 1017 PROBE CLEANING PROCEDURES

A. DISASSEMBLY AND CLEANING:

It is impossible for the sensitive aperture in the probe to be covered by a window of any sort which will permit the probe to operate normally.

So long as this aperture is open, foreign material may enter the volume associated with the vibrating vane and generate undesired noise or DC offset, thereby impairing the accuracy and utility of the instrument.

To maintain low noise and low offset, it is important that the probe be operated in as clean an environment as practicable, that it be purged with filtered air or an inert gas such as clean, dry nitrogen, and that it be periodically disassembled and cleaned.

Where practicable, it is recommended that the probe be installed with the sensitive aperture downward and when not in use, wrapped with aluminum foil.

The necessity for cleaning is indicated when:

1. The output as indicated by the meter or the recorded record is excessively noisy.

2. It is no longer possible to "null balance" the instrument using the BAL adjustment and still remain within the range of the ZERO adjustment.

Cleaning Procedure #1

1. Disconnect probe cord from main unit.

2. Remove probe from fixturing device if used.

3. Remove screw closest to sensitive aperture and loosen screw closest to cable end.

4. Carefully slide cover directly off of probe.

NOTE: Some probes have one or more shims between the base and the case. These will fall out of the case when it is removed. Retain them.

5. Once the case is removed and until it is replaced, the two vanes are exposed and subject to damage, therefore, during cleaning VERY CAREFUL HANDLING is required.

6. Cleaning should be done with MILLER-STEPHENSON T-P35 solvent.

7. Areas to be checked for cleanliness are:

   a.) Sensitive electrode.

   b.) Two vanes, especially in the area of the sensitive electrode (both sides).

   c.) The aperture in the case and surrounding area (inside and out).

8. CAREFULLY slide case back onto probe. Shim(s), if any, should be slid into the case first in such a way that the hole in the shim(s) will be lined up with the screw hole (in the case) closest to the aperture so that when the screw is replaced, it will extend through the shim(s) before entering the threaded hole in the probe base.

9. The toe of the base plate should abut the inner surface of the end of the case.

10. Tighten screws with torque consistent with their size.

Cleaning Procedure #2

NOTE: Use this procedure only if aperture diameter is 1.75 mm or greater.

1. Disconnect probe cord from main unit.

2. Immerse approximately 1 cm of the end of the probe in the cleaning fluid.

NOTE: Cleaning solvent to be CLEAN ethyl or isopropyl alcohol.

3. Clean until no dirt is visible in aperture.

4. Allow all solvent to evaporate before operating probe.

Cleaning Procedure #3

(Using ultrasonic cleaner for probes with small apertures.)

1. Remove case as described in Cleaning Procedure #1.

2. Immerse end of vanes and electrode housing in clean isopropyl alcohol in ultrasonic cleaner, when clean, set aside to allow solvent to evaporate.

3. Clean case thoroughly in same solvent.

4. Reassemble as in Cleaning Procedure #1.

APPENDIX IV

MODELS 1017E/22D AND 1017S/22D GRADIENT ADAPTERS

A. DESCRIPTION:

These gradient adapters are accessories to the Monroe Electronics, Inc., Model 244A ISOPROBE® Electrostatic Voltmeter and permit its use as an elec trostatic fieldmeter with direct readout in volts per millimeter of separation between the surface under test (SUT) and the grounded plate of the adapter.

They consist of a gold plated metal plate one inch square with a carefully chosen aperture through which the Model 1017 probe "looks", a 10 foot flexible grounding wire with clip and a small insulated box which is designed to slip over the end of the 1017 probe. A screw slot is provided for the purpose of locking the adapter to the probe.

B. INSTALLATION:

Remove the #0-80 x $^{3}/_{32}$" machine screw from the end of the probe nearest the sensitive aperture. In probes which have not been modified after shipment from the factory, this will be the only screw visible. (Another is hidden in the protective sleeve over the cable end of the probe.)

CAUTION: Inside some 1017E probes, there is a small shim which is retained by this screw. The probe should be held with the aperture pointing downward and jarred as little as possible while the screw is not in place to prevent the shim from shifting.

Replace the screw just removed with the longer #0-80 x $^{3}/_{16}$" machine screw furnished with the gradient adapter and slide the adapter onto the probe. Snug the screw against the body of the adapter and back off ¼ turn. DO NOT OVERTIGHTEN.

The adapter is now prepared for calibration.

C. CALIBRATION:

Calibration of the Model 1017E/22D Gradient Adapter is achieved by sliding the adapter forward or backward on the probe until the ISOPROBE® Voltmeter output indicates exactly one tenth of a known applied reference voltage at 1 cm probe-to-surface spacing.

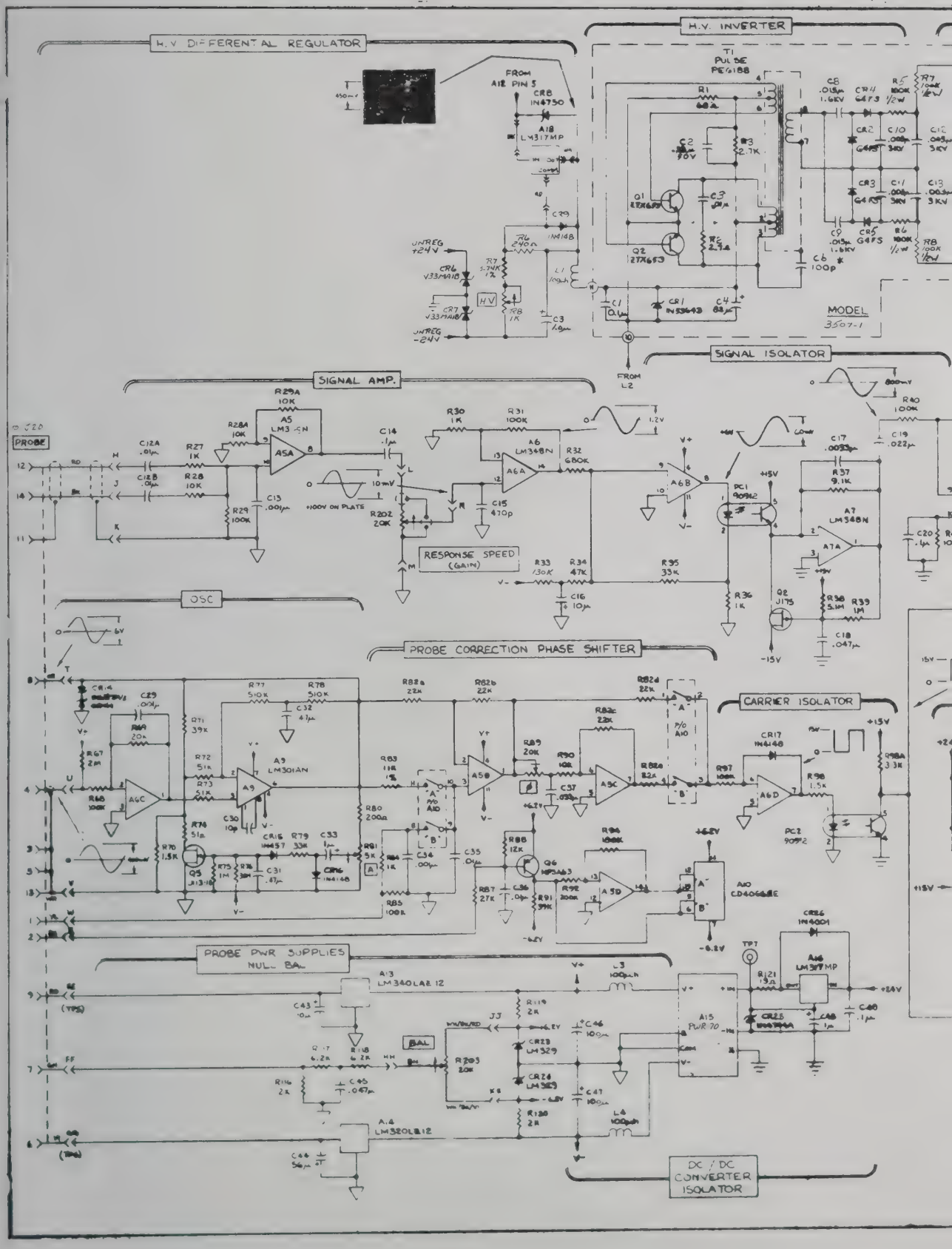
Calibration of the Model 1017S/22D Gradient Adapter is accomplished by off-centering the aperture of the gradient adapter in relation to the aperture of the probe until the ISOPROBE® Voltmeter output indicates exactly one tenth of a known applied reference voltage at 1 cm probe-to-surface spacing. This off-centering action is accomplished by sliding the adapter forward or backward on the probe case.

NOTE: In either event above, the Gradient Adapter plate should be grounded to the Model 244A frame and the instrument must be properly zeroed. (See operating instructions).

Tighten the screw sufficiently to hold the adapter in place and recheck calibration.

VENDOR CODES

Code	Vendor
ABY	ALLEN BRADLEY
AML	AMPHENOL
AMP	AMP INCORPORATED
ARO	ARCO
BEC	BECKMAN
BNS	BOURNS
CDE	CORNELL-DUBILIER
CKI	C&K COMPONENTS INCORPORATED
CRL	CENTRALAB
DLE	DALE
ELC	ELECTROCUBE
FEI	FERRANTI ELECTRIC INCORPORATED
FSC	FAIRCHILD
GCT	GENERAL CEMENT (GC ELECTRONICS)
GEC	GENERAL ELECTRIC
HAR	HAMLIN REED
HPD	HEWLETT PACKARD
HVC	HV COMPONENT ASSOC. INC.
ISI	INTERSIL INCORPORATED (HARRIS)
KMT	KEMET
KOA	KOA
LTF	LITTELFUSE
MEI	MONROE ELECTRONICS INC.
MOT	MOTOROLA
NSC	NATIONAL SEMICONDUCTOR
OMT	OHMITE
PAN	PANASONIC
PEI	PULSE ENGINEERING INCORPORATED
RCA	RADIO CORPORATION OF AMERICA
RCT	RECTRON
SGS	SGS
SLI	SILICONIX INCORPORATED
SPG	SPRAGUE
SUR	SCHURTER
TLD	TELEDYNE
TXI	TEXAS INSTRUMENTS
ZTX	ZETEX


H.V. DIFFERENTIAL REGULATOR
H.V. INVERTER
SIGNAL AMP.
SIGNAL ISOLATOR
OSC
PROBE CORRECTION PHASE SHIFTER
CARRIER ISOLATOR
PROBE PWR SUPPLIES
NULL BAL
DC / DC CONVERTER ISOLATOR
RESPONSE SPEED (GAIN)
MODEL 3507-1
PROBE
FROM A12 PIN 5
FROM L2
UNREG +24V
UNREG -24V
T1 PULSE PE6188
LM317MP
LM348N
LM340LAZ-12
LM329
CD4066BE
PWR 70
90912
J113
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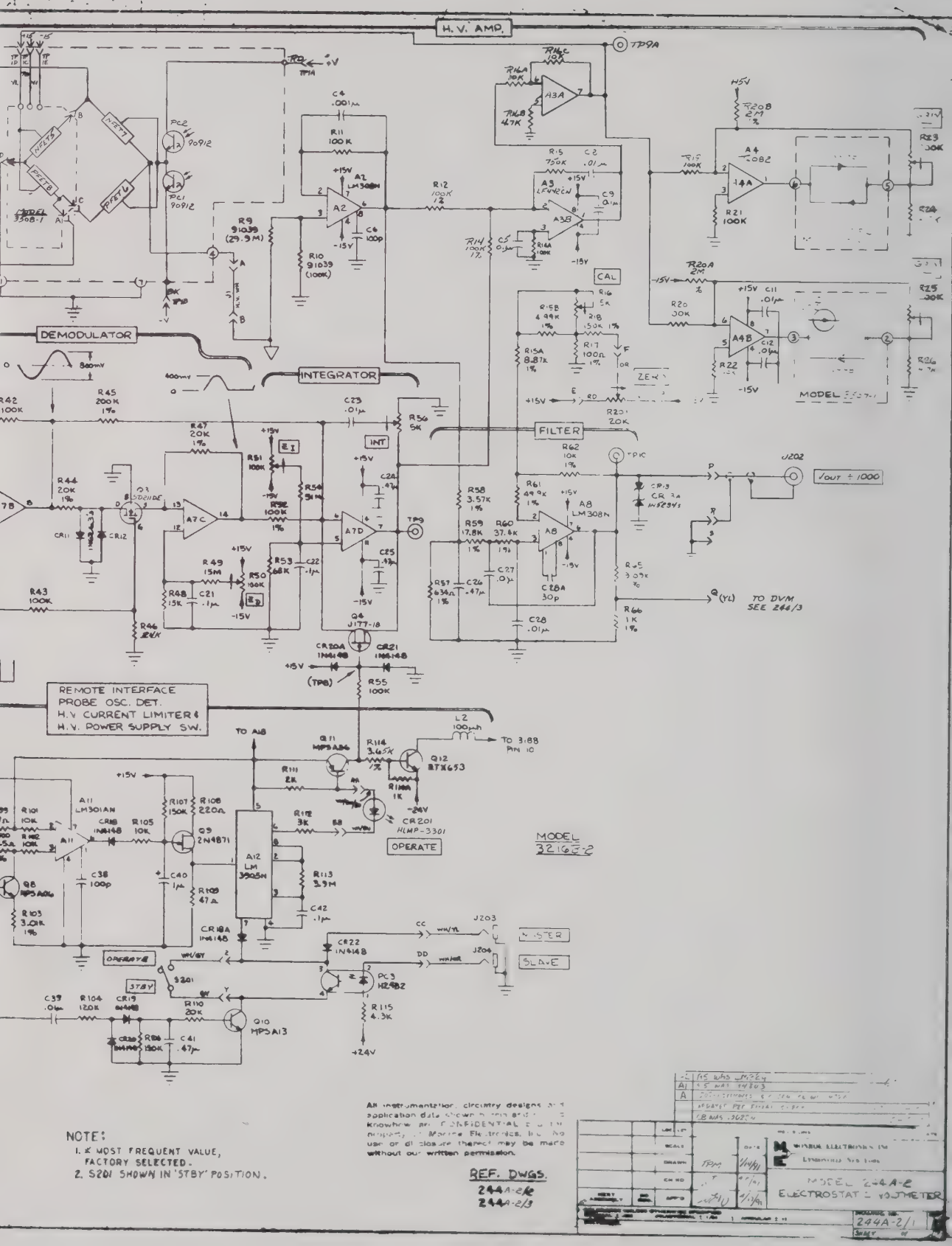
BAL
TP1
(TPS)
(TPM)



NOTE:
1. K MOST FREQUENT VALUE, FACTORY SELECTED.
2. S201 SHOWN IN 'STBY' POSITION.

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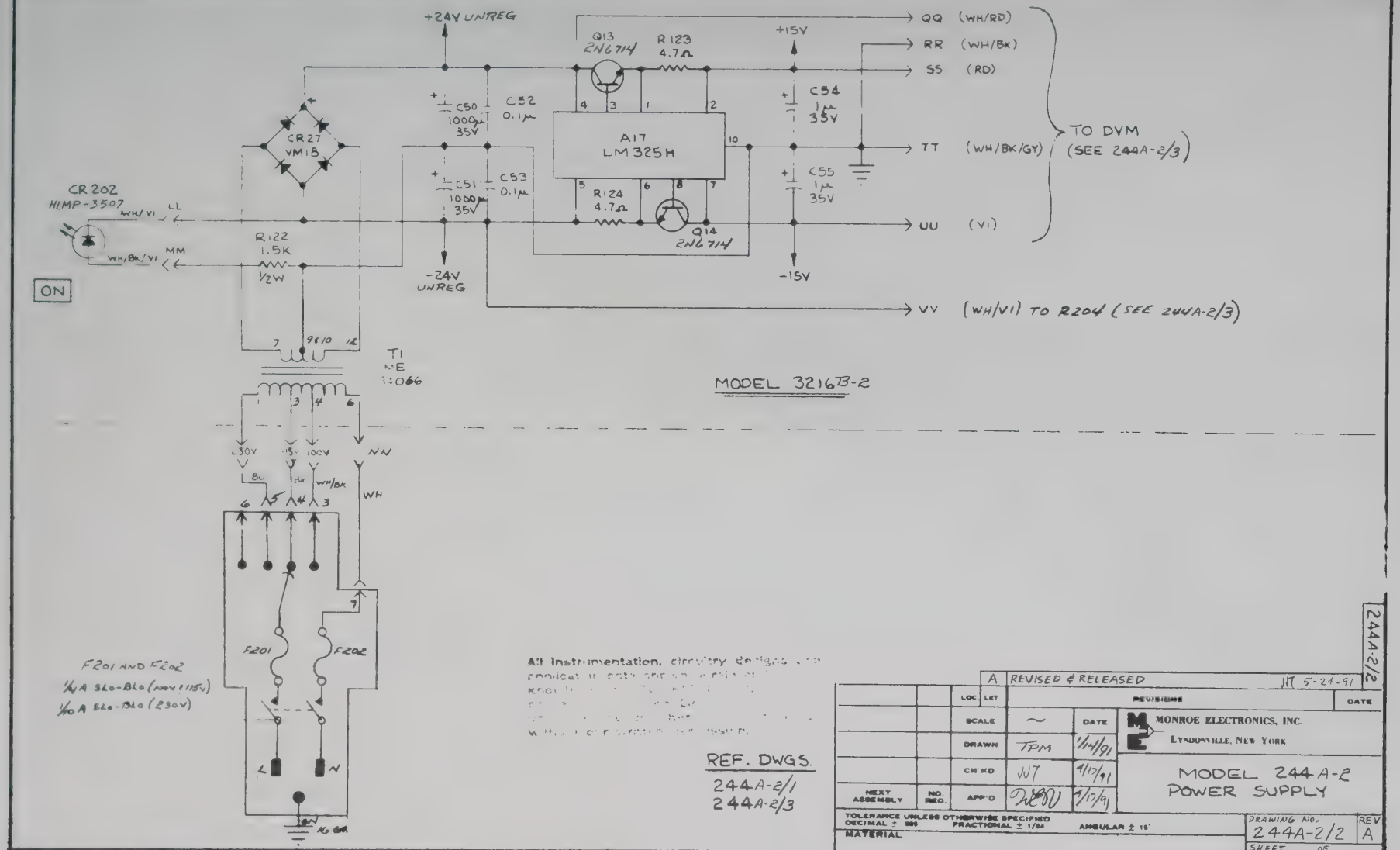
REF. DWGS.
244A-2/2
244A-2/3



		A	REVISED & RELEASED	JT	5-24-91
		LOC. LET	REVISIONS		DATE
		SCALE	~	DATE	
		DRAWN	TPM		4/17/91
		CH'KD	JT		4/17/91
NEXT ASSEMBLY	NO. REQ.	APP'D			4/17/91

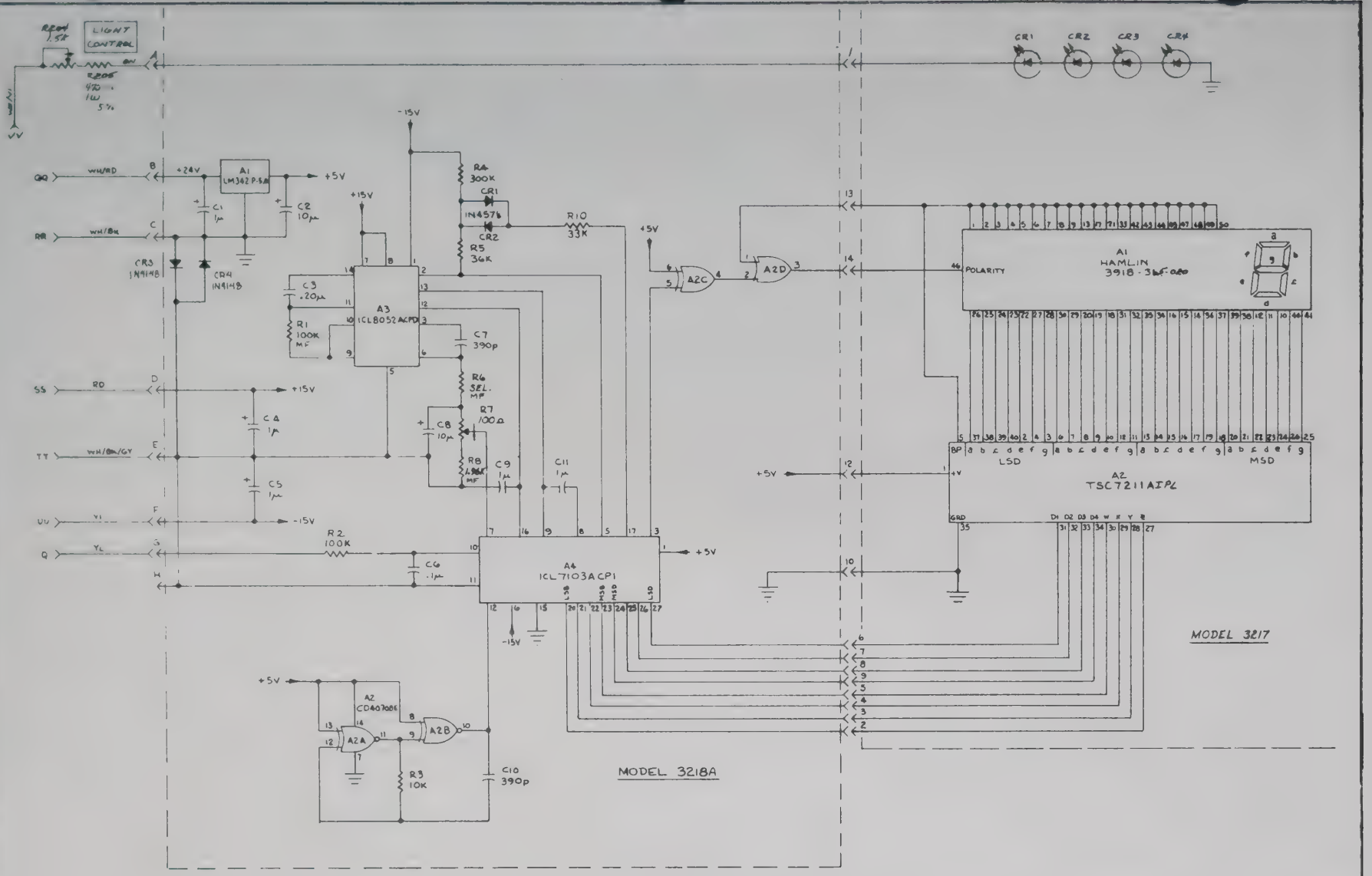
MONROE ELECTRONICS, INC.
LYNDONVILLE, NEW YORK

MODEL 244A-2
POWER SUPPLY

TOLERANCE UNLESS OTHERWISE SPECIFIED
DECIMAL ± .005 FRACTIONAL ± 1/64 ANGULAR ± 1°
MATERIAL

DRAWING NO. 244A-2/2 REV A
SHEET OF

244A-2/2



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REF. DWGS
244A-2/1
244A-2/2

REVISIONS			
A1	R205 WAS 220Ω 2W	mg	12-16-92
A	3218A WAS 3218		5-7-91

SCALE	~	DATE	
DRAWN	TBM		1/4/91
CHKD.	WT		4/19/91
APP'D	[illegible]		5/7/91

MONROE ELECTRONICS, INC.
LYNDONVILLE, New York

MODEL 244A-2
DIGITAL DISPLAY

DRAWING NO. 244A-2/3

TOLERANCES UNLESS OTHERWISE SPECIFIED: DECIMAL ± .005 FRACTIONAL ± 1/64 ANGULAR ± 0°
MATERIAL

Rev 244

MATERIAL LIST

MODEL 244A ELECTROSTATIC VOLTMETER

DESCRIPTION	VENDOR NO.	REF. NO.
RESISTOR 220 OHM 2W 5%	ABY HB2215	R205
POT 20K OHM,CERMET 10%,.625 SHAFT	ABY 70B1G040K203W	R201
POT 1.5K OHM	OMT CLU-1521	R204
POT 20K OHM,PLASTIC 20%,.750 SHAFT,CW	ABY 72A1N048S203R	R202
POT 20K OHM	BEC 7276R20KL.25	R203
LED RD	HPD HLMP-3301	CR201
LED GN	HPD HLMP-3507	CR202
IC, POS ADJ/500MA TO-202 VREG	NSC LM317MP	A18
SWITCH LEVER SPDT SEALED	CKI 7101-J61-Z-Q-I	S201
FUSE 1/4A SLO-BLO FOR 100 & 120V	LTF 313.250	F201,202
FUSE 1/4A SLO-BLO FOR 220V	LTF 313.100	F201,202
FUSEDRAWER DOUBLE POLE	SUR 4303.2714.01	
CONNECTOR CASING AC, DOUBLE POLE W/SW	SUR KD14.4101.151	
CONNECTOR	AML 31-10	J202
CONNECTOR TERMINAL	AMP 61276-1	
CONNECTOR TERMINAL PIN	AMP 66594-2	
CONNECTOR RECEPTACLE PIN	AMP 60888-3	
CONNECTOR	AMP 206043-1	J201
MINI PHONO JACK	GCT 30-546	J203,204

MATERIAL LIST

MODEL 3216B-2 for MODEL 244A-2 MAIN ELECTRONICS

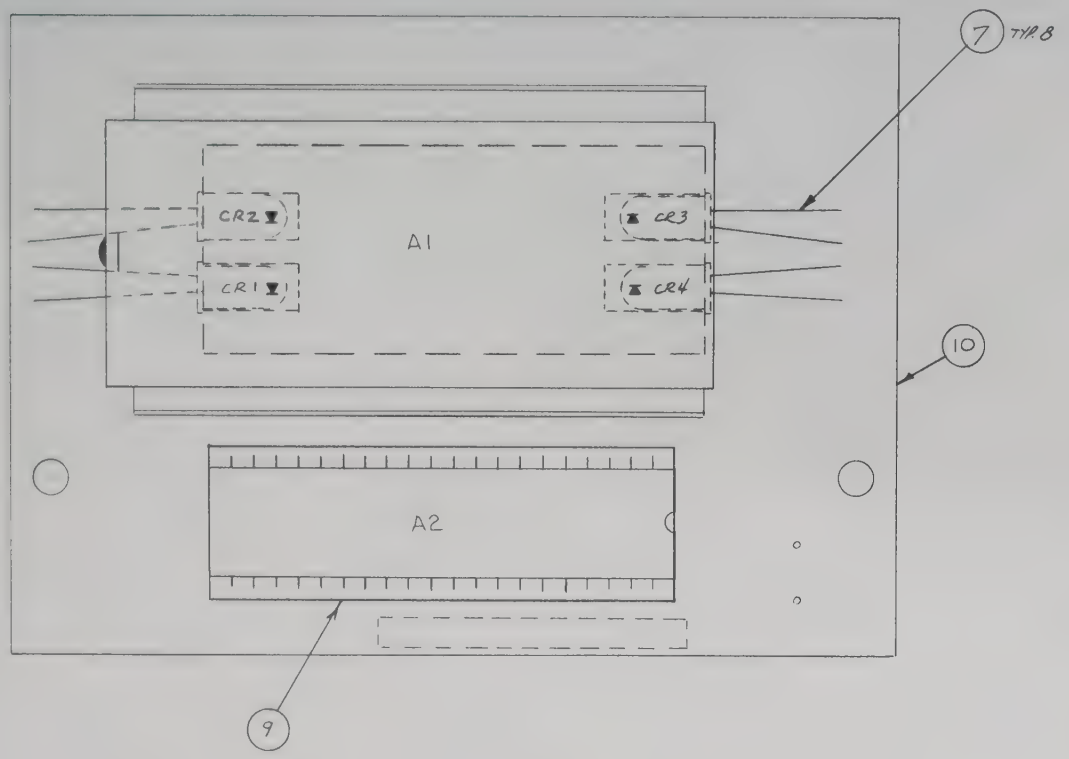
DESCRIPTION	VENDOR NO.	REF. NO.
RESISTOR 29.9M,100K 3000V 1% DIVIDER	MEI 91039	R9,10
PHOTOCOUPLER ME90912	MEI 90912	PC1,2
94066 TRANSFORMER	MEI 94066	T1
94803 DC-DC CONVERTER	MEI 94803	A15
RESISTOR 2.7 OHM 1/4W 5%	KOA 2.7	R99
RESISTOR 4.7 OHM 1/4W 5%	KOA 4.7	R123,124
RESISTOR 13 OHM 1/4W 5%	KOA 13	R121
RESISTOR 47 OHM 1/4W 5%	KOA 47	R109
RESISTOR 51 OHM 1/4W 5%	KOA 51	R74
RESISTOR 200 OHM 1/4W 5%	KOA 200	R80
RESISTOR 220 OHM 1/4W 5%	KOA 220	R108
RESISTOR 240 OHM 1/4W 5%	KOA 240	R6
RESISTOR 1.0K OHM 1/4W 5%	KOA 1.0K	R27,30,36,84,114A
RESISTOR 1.5K OHM 1/4W 5%	KOA 1.5K	R70,98
RESISTOR 2.0K OHM 1/4W 5%	KOA 2.0K	R111,116,119,120
RESISTOR 3.0K OHM 1/4W 5%	KOA 3.0K	R112
RESISTOR 3.3K OHM 1/4W 5%	KOA 3.3K	R98A
RESISTOR 4.3K OHM 1/4W 5%	KOA 4.3K	R115
RESISTOR 4.7K OHM 1/4W 5%	KOA 4.7K	R16B,24,26
RESISTOR 6.2K OHM 1/4W 5%	KOA 6.2K	R117,118
RESISTOR 9.1K OHM 1/4W 5%	KOA 9.1K	R37
RESISTOR 10K OHM 1/4W 5%	KOA 10K	R16A,16C,28,28A,29A,90, 101,102,105
RESISTOR 12K OHM 1/4W 5%	KOA 12K	R88
RESISTOR 15K OHM 1/4W 5%	KOA 15K	R48
RESISTOR 20K OHM 1/4W 5%	KOA 20K	R69,110

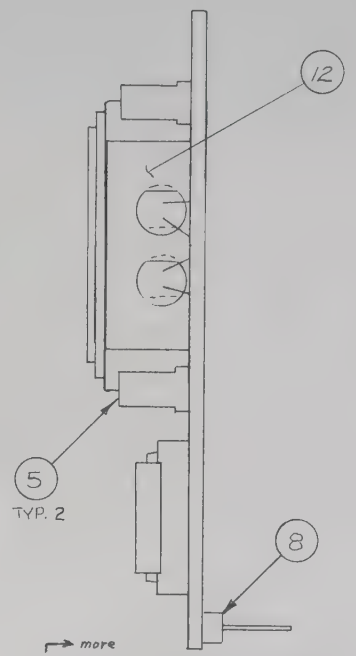
DESCRIPTION	VENDOR NO.	REF. NO.
RESISTOR 24K OHM 1/4W 5%	KOA 24K	R46
RESISTOR 27K OHM 1/4W 5%	KOA 27K	R87
RESISTOR 33K OHM 1/4W 5%	KOA 33K	R35,79
RESISTOR 39K OHM 1/4W 5%	KOA 39K	R71,91
RESISTOR 47K OHM 1/4W 5%	KOA 47K	R34
RESISTOR 51K OHM 1/4W 5%	KOA 51K	R72,73
RESISTOR 68K OHM 1/4W 5%	KOA 68K	R53
RESISTOR 100K OHM 1/4W 5%	KOA 100K	R11,14A,19-22,29,31,40, 41,42,43,55,68,85,97
RESISTOR 120K OHM 1/4W 5%	KOA 120K	R104
RESISTOR 130K OHM 1/4W 5%	KOA 130K	R33
RESISTOR 150K OHM 1/4W 5%	KOA 150K	R106,107
RESISTOR 180K OHM 1/4W 5%	KOA 180K	R94
RESISTOR 200K OHM 1/4W 5%	KOA 200K	R92
RESISTOR 510K OHM 1/4W 5%	KOA 510K	R77,78
RESISTOR 680K OHM 1/4W 5%	KOA 680K	R32
RESISTOR 750K OHM 1/4W 5%	KOA 750K	R15
RESISTOR 1.0M OHM 1/4W 5%	KOA 1.0M	R39,75
RESISTOR 2.0M OHM 1/4W 5%	KOA 2.0M	R67
RESISTOR 3.9M OHM 1/4W 5%	KOA 3.9M	R113
RESISTOR 5.1M OHM 1/4W 5%	KOA 5.1M	R38
RESISTOR 15M OHM 1/4W 5%	KOA 15M	R49
RESISTOR 30M OHM 1/4W 5%	ABY CB3065	R76
RESISTOR 51M OHM 1/4W 5%	ABY CB5165	R54
RESISTOR 1.5K OHM 1/2W 10%	ABY EB1521	R122
RESISTOR 100 OHM 1/8W 1% 50PPM	MF55C100	R17
RESISTOR 4.99K OHM 1/8W 1% 50PPM	MF55C4.99K	R15B

DESCRIPTION	VENDOR NO.	REF. NO.
RESISTOR 150K OHM 1/8W 1% 50PPM	MF55C150K	R18
RESISTOR 84.5 OHM 1/8W 1% 100PPM	MF55D84.5	R100
RESISTOR 634 OHM 1/8W 1% 100PPM	MF55D634	R57
RESISTOR 1.00K OHM 1/8W 1% 100PPM	MF55D1.00K	R66
RESISTOR 3.01K OHM 1/8W 1% 100PPM	MF55D3.01K	R103
RESISTOR 3.57K OHM 1/8W 1% 100PPM	MF55D3.57K	R58
RESISTOR 3.74K OHM 1/8W 1% 100PPM	MF55D3.74K	R7
RESISTOR 8.87K OHM 1/8W 1% 100PPM	MF55D8.87K	R15A
RESISTOR 9.09K OHM 1/8W 1% 100PPM	MF55D9.09K	R65
RESISTOR 10.0K OHM 1/8W 1% 100PPM	MF55D10.0K	R62
RESISTOR 11.0K OHM 1/8W 1% 100PPM	MF55D11.0K	R83
RESISTOR 17.8K OHM 1/8W 1% 100PPM	MF55D17.8K	R59
RESISTOR 37.4K OHM 1/8W 1% 100PPM	MF55D37.4K	R60
RESISTOR 49.9K OHM 1/8W 1% 100PPM	MF55D49.9K	R61
RESISTOR 100K OHM 1/8W 1% 100PPM	MF55D100K	R12,14,52
RESISTOR 2.00M OHM 1/8W 1% 100PPM	MF55D2.00M	R20A,20B
RESISTOR 20.0K OHM 1/4W 1% 100PPM	MF60D20.0K	R44,47
RESISTOR 200K OHM 1/4W 1% 100PPM	MF60D200K	R45
RESISTOR 3.65K OHM 1W 1% 100PPM	MF70D3.65K	R114
POT 200K OHM	BEC 72PR200K	R23,25
POT 100K OHM	BEC 82PR100K	R51
POT 100K OHM	BEC 72PR100K	R50
POT 20K OHM	BEC 72PR20K	R89
POT 5K OHM	BEC 66WR5K	R16
POT 5K OHM	BEC 72PR5K	R56,81
POT 1K OHM	BEC 72PR1K	R8
RESISTOR NETWORK 22K OHM SIP	BNS 4610X-102-223	R82
CAPACITOR 0.01uf 50V POLY 5%	PAN ECQ-V1H103JZ	C8
CAPACITOR 100uf 25V ELE 20%	PAN ECE-A1EFS101	C46,47

DESCRIPTION	VENDOR NO.	REF. NO.
CAPACITOR 56uF 25V TAN 10%	SPG 199D566X9025FE3	C44
CAPACITOR 1uf 35V TAN 10%	SPG 199D105X9035AB2	C3,33,40,48,54,55
CAPACITOR .047uf 80V MYL 10%	SPG 192P4739R8	C18
CAPACITOR .033uf 80V MYL 10%	SPG 192P3339R8	C37
CAPACITOR .01uf 80V MYL 10%	SPG 192P103X908	C27,28,35
CAPACITOR .0033uf 80V MYL 10%	SPG 192P332X9080	C17
CAPACITOR .022uf 200V MYL 10%	SPG 192P22392	C19
CAPACITOR 10pf 500V MIC 5%	ARO DM15-100J	C30
CAPACITOR 30pf 500V MIC 5%	ARO DM15-300J	C28A
CAPACITOR 100pf 500V MIC 5%	ARO DM15-101J	C6,38
CAPACITOR 470pf 500V MIC 5%	ARO DM15-471J	C15
CAPACITOR 1000uf 35V ELE 20%	SPG 513D108M035EK4	C50,51
CAPACITOR .47uf 50V CER 20%	KMT C330C474M5U5CA	C24,25,31,32,41
CAPACITOR .1uf 50V CER 20%	CRL CY20C104M	C9,14,20-22,42,49,52,53
CAPACITOR .047uf 50V CER 20%	CRL CZ20C473M	C45
CAPACITOR .01uf 50V CER -0+100	CRL CY15C103P	C11,12,12A,12B,23,36,39
CAPACITOR .001uf 50V CER 20%	CRL CY15C102M	C4,13,29,34
CAPACITOR .47uf 50V MYL +/-10%	CDE WMF05P47K	C26
CAPACITOR .1uf 50V CER 20%	KMT C410C104M5U5CA	C5
CAPACITOR 10uf 25V TAN 10%	SPG 199D106X9025CA1	C16,43
BRIDGE	RCT DB104	CR27
DIODE	NSC LM329DZ	CR23,24
DIODE	MOT 1N4001	CR26
DIODE	FSC 1N4148	CR9,16-18,18A,19,20,20A, 21,22
DIODE	MOT 1N4744A	CR25
DIODE	MOT 1N4750	CR8
DIODE	MOT 1N5234	CR13,13A,14,14A
DIODE MOV	GEC V33MA1B	CR6,7
DIODE	SGS 1N6263	CR11,12
DIODE	MOT 1N457	CR15
PHOTOCOUPLER	GEC H24B2	PC3

DESCRIPTION	VENDOR NO.	REF. NO.
TRANSISTOR	MOT 2N4871	Q9
TRANSISTOR	NSC 2N6714	Q13,14
TRANSISTOR	SLI J113-18	Q5
TRANSISTOR	SLI J175	Q2
TRANSISTOR	SLI J177-18	Q4
TRANSISTOR	SLI SD211DE	Q3
TRANSISTOR	MOT MPS-A06	Q8
TRANSISTOR	MOT MPS-A13	Q10
TRANSISTOR	MOT MPS-A56	Q11
TRANSISTOR	MOT MPS-A63	Q6
TRANSISTOR	FEI ZTX653	Q12
IC, LIN 16486 GENERAL PURPOSE BIFET OP AMP	TXI TL082CP	A4
IC, UNCOMP OP AMP	NSC LM301AN	A9,11
IC, SUPER GAIN OP AMP	NSC LM308N	A2,8
IC, POS ADJ/500MA TO-202 VREG	NSC LM317MP	A16
IC, -12V/100MA TO-92 VREG	NSC LM320LZ-12	A14
IC, QUAD OP AMP	NSC LM324N	A5
IC, +/-15V/100MA TO-5 VREG	NSC LM325H	A17
IC, +12V/100MA TO-92 VREG	NSC LM340LAZ-12	A13
IC, QUAD 741 OP AMP	NSC LM348N	A6,7
IC, LO-PWR BIFET OP AMP (DUAL)	NSC LF442CN	A3
IC, PRECISION TIMER	NSC LM3905N	A12
IC, QUAD BILATERAL SWITCH	RCA CD4066BE	A10
CHOKE 100uH	DLE IR-2-100-10	L1-4





more

C_2	DELETE C1 VT 6-6-89	TRB 06-06-89	
C_1	OMIT CR1-4, BACKLIGHT Block	TPM 10-3-88	
C	ADDED ITEM 9	MN 20 FEB 80	
B	REV. LAMPS WERE CM8-885-F1	BWC 10-A-78	
A	ADDED SHT 1	BWC 12-15-77	
	LOC. LET	REVISIONS	DATE

3217/22
SHT 1 of 2

		SCALE	2:1	DATE	
		DRAWN	BWC	12/15/77	
		CH KD	VT	6/6/89	
NEXT ASSEMBLY	NO REQ	APP'D		6 22 79	

MONROE ELECTRONICS, INC.
LYNDONVILLE, NEW YORK

MODEL 3217
DIGITAL DISPLAY

TOLERANCE UNLESS OTHERWISE SPECIFIED
DECIMAL ± .005 FRACTIONAL ± 1/64 ANGULAR ± 15'
MATERIAL

3217/22
SHT 1 of 2

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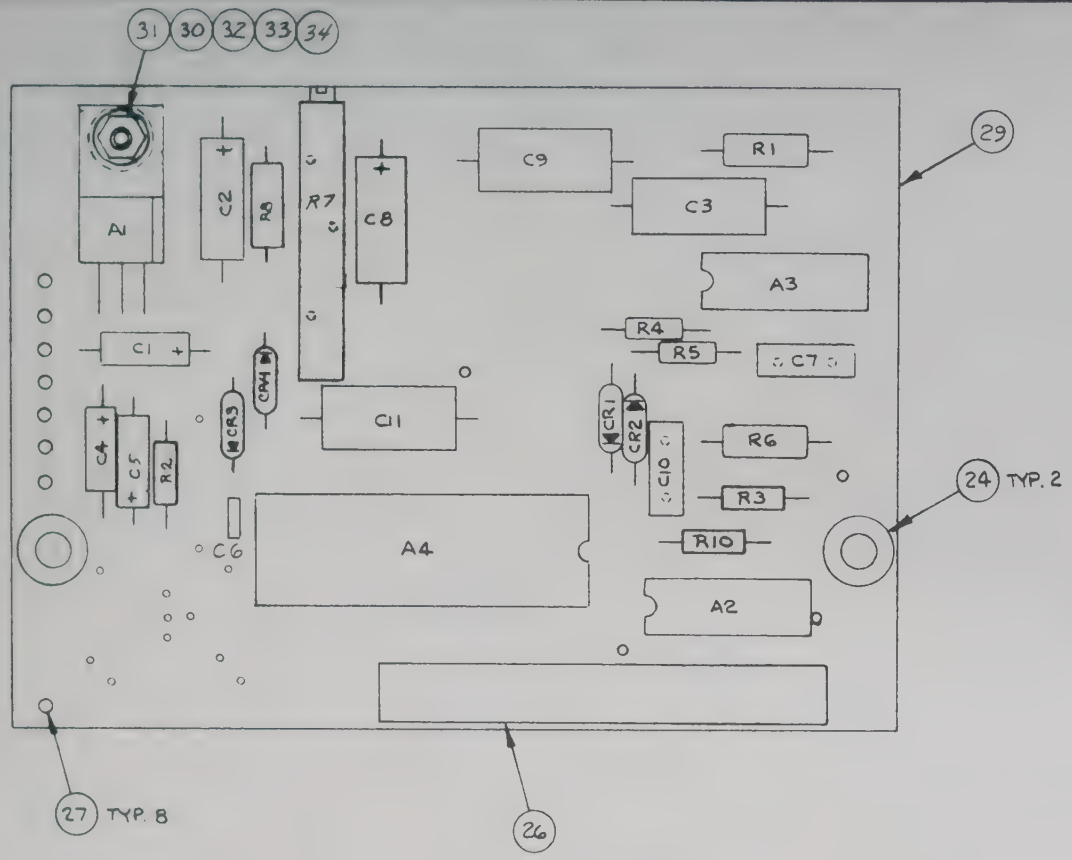

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		F	TEM. 30 WAS MOT E09002A001	MG 11-21-94	
		LOC	LET	REVISIONS	DATE
		SCALE	2:1	DATE	MONROE ELECTRONICS, INC. LYNDONVILLE, NEW YORK
		DRAWN	JN	4/25/91	
		CH'KD	JJT	5/17/91	MODEL 3218A DIGITAL DISPLAY DRIVER
NEXT ASSEMBLY	NO REQ	APP'D	CYP	5/20/91	

TOLERANCE UNLESS OTHERWISE SPECIFIED
DECIMAL ± .005 FRACTIONAL ± 1/64 ANGULAR ± 15'
MATERIAL

DRAWING NO. 3218A/22 REV A
SHEET 1 of 3

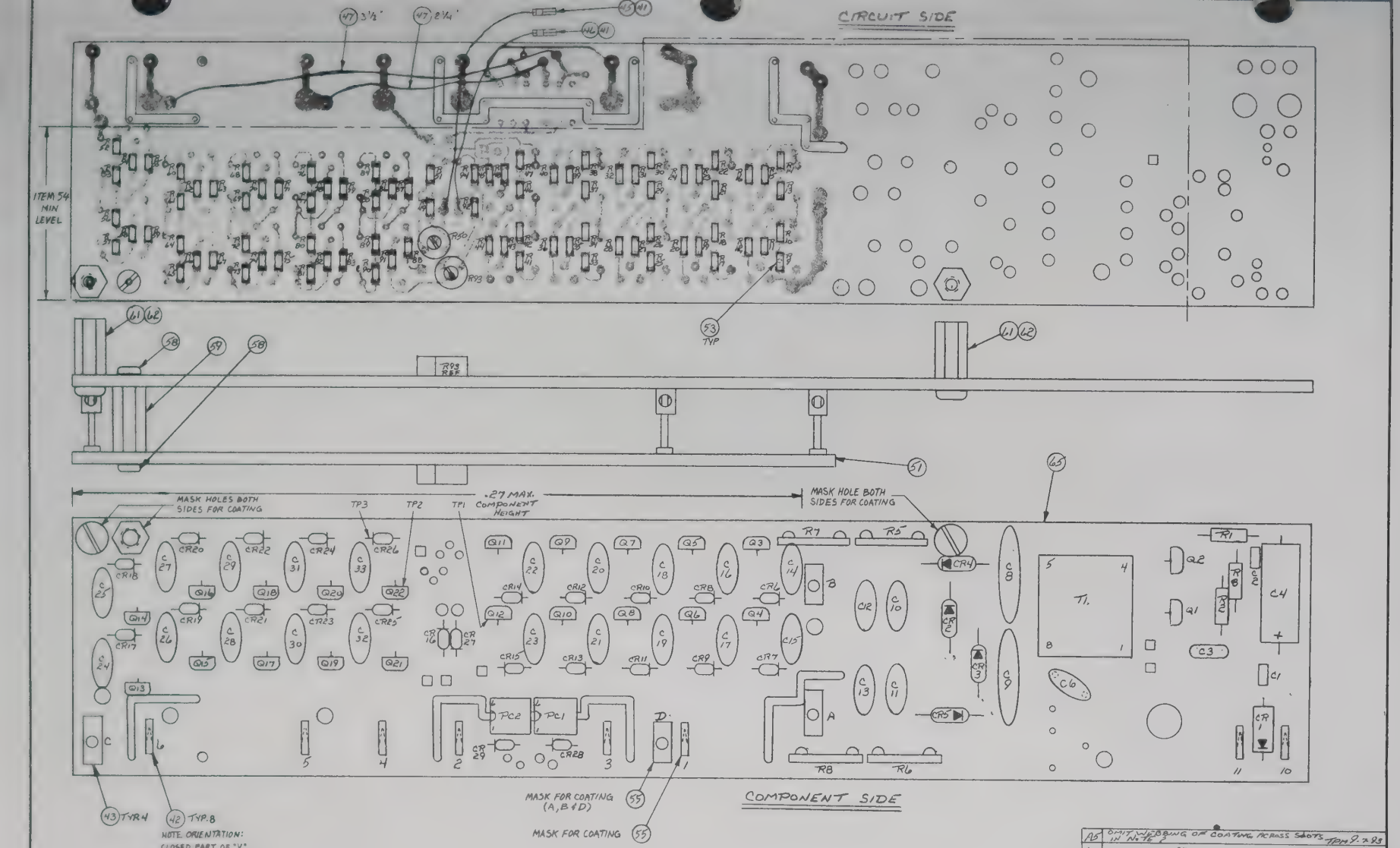
3218A/22 SHT 1 of 3

B40 0910146

MATERIAL LIST

MODEL 3218A DISPLAY DRIVER

DESCRIPTION	VENDOR NO.	REF. NO.
SELECT RESISTOR ANY WATT,OR %	UNKNOWN	R6
RESISTOR 10K OHM 1/4W 5%	KOA 10K	R3
RESISTOR 33K OHM 1/4W 5%	KOA 33K	R10
RESISTOR 36K OHM 1/4W 5%	KOA 36K	R5
RESISTOR 100K OHM 1/4W 5%	KOA 100K	R2
RESISTOR 300K OHM 1/4W 5%	KOA 300K	R4
RESISTOR 1.96K OHM 1/8W 1% 100PPM	MF55D1.96K	R8
RESISTOR 100K OHM 1/8W 1% 100PPM	MF55D100K	R1
POT 100 OHM	BEC 78PR100	R7
CAPACITOR 10uf 20V TAN 10%	SPG 150D106X9020B2	C2,8
CAPACITOR 1uf 35V TAN 10%	SPG 150D105X9035A2	C1,4,5
CAPACITOR 390pf 500V MIC 5%	ARO DM15-391J	C7,10
CAPACITOR 1uf 50V MPC 10%	ELC 625B1A105K	C9,11
CAPACITOR .2uf 100V MPC 10%	ELC 650B1B204K	C3
CAPACITOR .1uf 50V CER 20%	CRL CY20C104M	C6
DIODE	FSC 1N4148	CR3,4
DIODE	FSC 1N457A	CR1,2
IC, +5.0V/250MA TO-202 VREG	NSC LM342P-5.0	A1
IC, QUAD XOR GATE	RCA CD4070BE	A2
IC	ISI ICL71C03ACPI	A4
IC	ISI ICL8052ACPD	A3



NOTE:

1. CLEAN FINAL P.C. BOARD ASSY PER ME STANDARD AND PROCEDURES 102-6, PRIOR TO CONFORMAL COATING
2. CONFORMAL COAT AS INDICATED USING ITEM 54, THICKNESS TO BE 3-7 mil.

MASK MOUNTING HOLE BOTH SIDES. APPLY COATING PRIOR TO ASSEMBLY OF STANDOFFS AND P.C. BOARD ASSY (ITEM 51). TERMINALS (ITEM 41) MUST BE FREE OF COATING.

REV	DESCRIPTION	DATE
A5	OMIT WRAPPING OF COATING ACROSS SLOTS IN NOTE 2	TPM 9-7-93
A4	ITEM 47 WAS 2"	DSD 7-3-92
A3	ADDED NOTE FOR INSTALLING ITEM 42	WT 12-12-91
A2	REMOVED C5, C7, R4; CHANGED C6	WT 10-30-91
A1	OMITTED CALLOUT OF ITEM 55 AT PARA NOTE	JW 8-9-91
A	REVISED & RELEASED	WT 5-8-91

		LOC	LEY	REVISIONS	DATE
		SCALE	2:1	DATE	MONROE ELECTRONICS, INC. LYNDONVILLE, NEW YORK
		DRAWN	TPM	11/7/91	
		CH'KD	WT	5/8/91	MODEL 3507-1 H.V. FET MODULE
NEXT ASSEMBLY	NO REQ	APP'D	[illegible]	5/6/91	

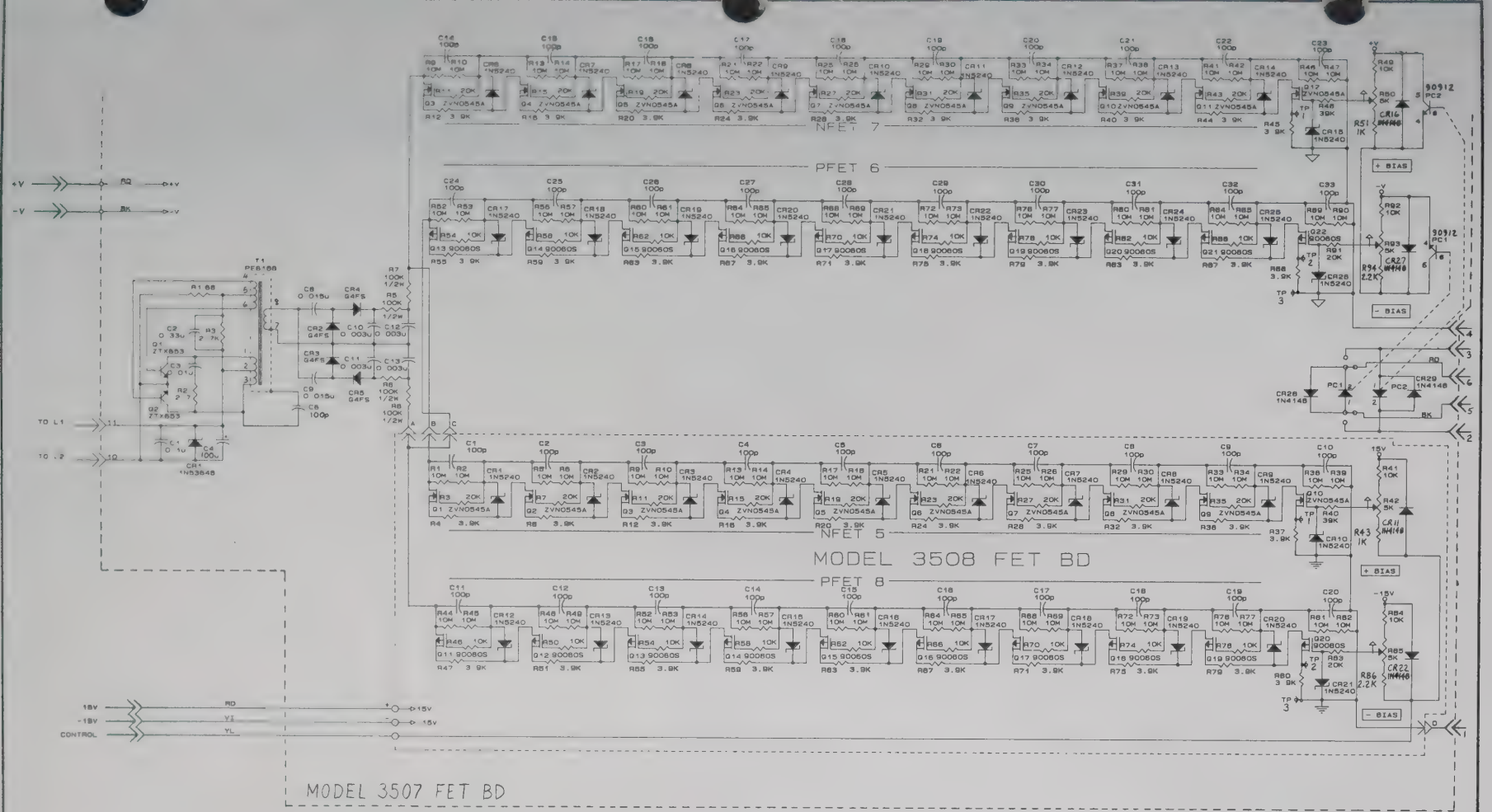
TOLERANCE UNLESS OTHERWISE SPECIFIED DECIMAL ± .005 FRACTIONAL ± 1/64 ANGULAR ± 15°

MATERIAL

DRAWING NO. 3507-1/22 REV AB

SIZE D

0910012



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REV	LOC	LET	REVISIONS	DATE
A1			REMOVED C5, C7 & R4 ; C6 WAS 470 P	HT 10-30-91
A			REVISED & UPDATED; WAS 3507-1/1; C9 WAS 82n	HT 5-8-91

SCALE	~	DATE	MONROE ELECTRONICS, INC.	
DRAWN	TPM	3/4/91	LYNDONVILLE, NEW YORK	
CH'KD	HT	4/17/91	MODEL 3507 H.V. FET MODULE	
NEXT ASSEMBLY	NO REC	APP'D		
MATERIAL			DRAWING NO. 3507/1	REV A1

TOLERANCE UNLESS OTHERWISE SPECIFIED
DECIMAL ± .005 FRACTIONAL ± 1/64 ANGULAR ± 1°

6D

1/L05E

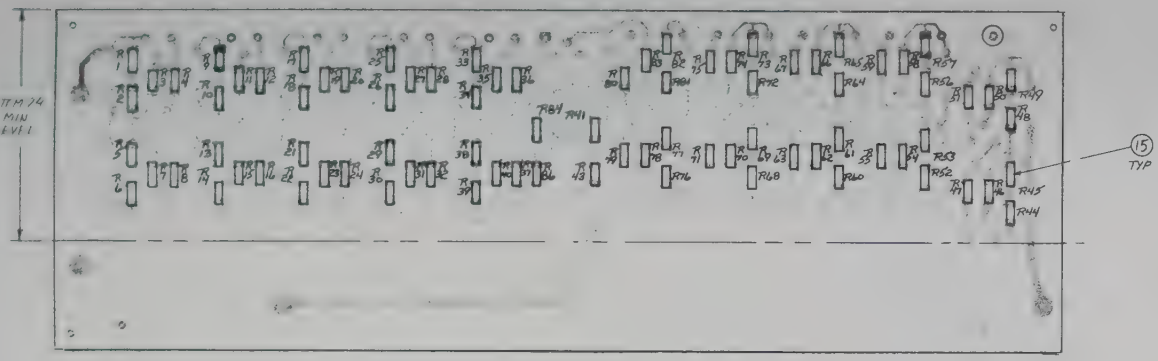
MATERIAL LIST

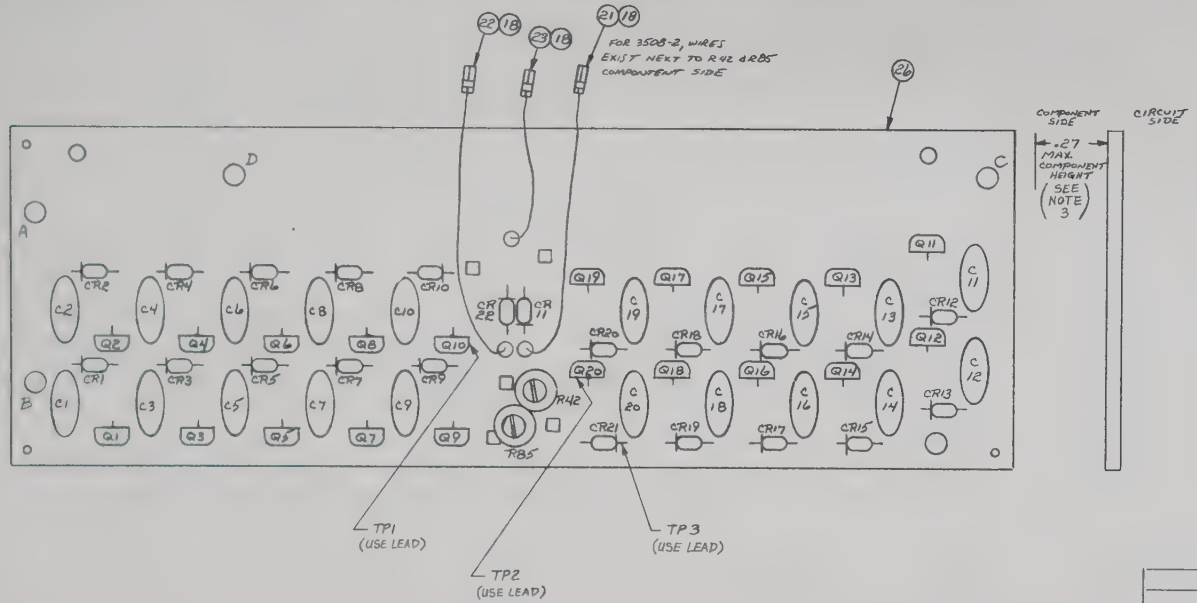
MODEL 3507-1 HV FET MODULE

DESCRIPTION	VENDOR NO.	REF. NO.
PHOTOCOUPLER ME90912	MEI 90912	PC1,2
TRANSISTOR-FETME90060S SELECT WHITE DOT	MEI 90060S	Q13-22
SELECT RESISTOR ANY WATT,OR %	UNKNOWN	R4
RESISTOR 2.7 OHM 1/4W 5%	KOA 2.7	R2
RESISTOR 68 OHM 1/4W 5%	KOA 68	R1
RESISTOR 2.7K OHM 1/4W 5%	KOA 2.7K	R3
RESISTOR 100K OHM 1/2W 1% 250PPM	KDI FL-1/2 100K 1%	R5-8
RESISTOR 2.2K OHM 1/8W 5% 200PPM SMD T&R	KOA RM73B2BT222J	R94
RESISTOR 1K OHM 1/8W 5% 200PPM SMD T&R	KOA RM73B2BT102J	R51
RESISTOR 10M OHM 5% 400PPM SMD T&R	KOA RM73B2BT106J	R9,10,13,14,17,18,21,22, 25,26,29,30,33,34,37, 38,41,42,46,47,52,53, 56,57,60,61,64,65,68, 69,72,73,76,77,80,81, 84,85,89,90
RESISTOR 39K OHM 1/8W 5% 200PPM SMD T&R	PAN ERJ-8GEYJ393V	R48
RESISTOR 3.9K OHM 1/8W 5% 200PPM SMD T&R	PAN ERJ-8GEYJ392V	R12,16,20,24,28,32,36,40, 44,45,55,59,63,67,71, 75,79,83,87,88
RESISTOR 20K OHM 1/8W 5% 400PPM SMD T&R	KOA RM73B2BT203J	R11,15,19,23,27,31,35,39, 43,91
RESISTOR 10K OHM 1/8W 5% 200PPM SMD T&R	KOA RM73B2BT103J	R49,54,58,62,66,70,74,78, 82,86,92
POT 5K OHM SNGL TURN	BNS 3329H-1-502	R50,93
CAPACITOR 0.01uf 50V POLY 5%	PAN ECQ-V1H103JZ	C3
CAPACITOR 100pf 500V CER	PAN ECK-D2H101KBE	C14-33
CAPACITOR 470pf 1000V CER 20%	SPG 5GA-T47	C6,7
CAPACITOR 100uf 63V ELE 20%	PAN ECE-B1JFS101	C4
CAPACITOR .1uf 50V CER 20%	CRL CY20C104M	C1
CAPACITOR .33uf 50V CER 20%	CRL CZ30C334M	C2
CAPACITOR .003uf 3KV CER 20%	CRL DD30-302	C10-13

DESCRIPTION	VENDOR NO.	REF. NO.
CAPACITOR .015uf 1.6KV CER -20+80	CRL DD16-153	C8,9
CAPACITOR,180-690pf VARIABLE	SPG GME50501	C5
DIODE HV	HVC G4FS	CR2-5
DIODE	FSC 1N4148	CR16,27,28,29
DIODE ZENER	MOT 1N5364B	CR1
DIODE	MOT 1N5240B	CR6-15,17-26
TRANSISTOR MOS-FET N-CHANNEL 450V	ZTX ZVN0545A	Q3-12
TRANSISTOR	FEI ZTX653	Q1,2
TRANSFORMER	PEI PE-6188	T1
CONNECTOR RECEPTACLE PIN	AMP 60888-3	
CONNECTOR TERMINAL SOCKET,RT ANGLE,TIN	AMP 85493-3	
TEST JACK RED	EFJ 105-0752-001	

CIRCUIT SIDE





NOTE:
1. CLEAN FINAL P.C. BOARD ASSY. PER ME STANDARD AND PROCEDURES 102-6, PRIOR TO CONFORMAL COATING.
2. CONFORMAL COAT AS INDICATED USING ITEM 24 THICKNESS TO BE 3-7 MIL. NO COATING ALLOWED ON PINS (ITEM 27) OR TERMINALS (ITEM 18).
3. CAPACITORS MAY BE TIPPED TO MEET MAXIMUM HEIGHT REQUIREMENT.
4. WIRE LENGTHS ARE DIFFERENT FOR -1 & -2 (SEE B/M'S)

REVISIONS				
LOC	LET			DATE
	A1	CLARIFY NTE OF ITEM R7	TPM	7-26-91
	A	REVISED & RELEASED	MT	4-25-91

SCALE 2:1 DATE
DRAWN TPM 7/15/91
CH'KD JJT 9/25/91
APP'D 4/25/91
NEXT ASSEMBLY
REQ

MONROE ELECTRONICS, INC.
LYNDONVILLE, NEW YORK

MODEL 3508-__
PIGGY BACK PCB

TOLERANCE UNLESS OTHERWISE SPECIFIED
DECIMAL ± .005 FRACTIONAL ± 1/64 ANGULAR ± 1°
MATERIAL

DRAWING NO. 3508-__/22 REV A1
SHT 1 OF 3

8201-LNS
22-805E

3508-1 6910813
3508-2 6910817

MATERIAL LIST

MODEL 3508-1 HV FET ASSY

DESCRIPTION	VENDOR NO.	REF. NO.
3508/41 TERM CONTACT	MEI 3508/41	
TRANSISTOR-FETME90060S SELECT WHITE DOT	MEI 90060S	Q11-20
RESISTOR 2.2K OHM 1/8W 5% 200PPM SMD T&R	KOA RM73B2BT222J	R86
RESISTOR 1K OHM 1/8W 5% 200PPM SMD T&R	KOA RM73B2BT102J	R43
RESISTOR 10M OHM 1/8W 5% 400PPM SMD T&R	KOA RM73B2BT106J	R1,2,5,6,9,10,13,14,17, 18,21,22,25,26,29,30, 33,34,38,39,44,45,48, 49,52,53,56,57,60,61, 64,65,68,69,72,73,76, 77,81,82
RESISTOR 39K OHM 1/8W 5% 200PPM SMD T&R	PAN ERJ-8GEYJ393V	R40
RESISTOR 3.9K OHM 1/8W 5% 200PPM SMD T&R	PAN ERJ-8GEYJ392V	R4,8,12,16,20,24,28,32, 36,37,47,51,55,59,63, 67,71,75,79,80
RESISTOR 20K OHM 1/8W 5% 400PPM SMD T&R	KOA RM73B2BT203J	R3,7,11,15,19,23,27,31, 35,83
RESISTOR 10K OHM 1/8W 5% 200PPM SMD T&R	KOA RM73B2BT103J	R41,46,50,54,58,62,66,70, 74,78,84
POT 5K OHM SNGL TURN	BNS 3329H-1-502	R42,85
CAPACITOR 100pf 500V CER	PAN ECK-D2H101KBE	C1-20
DIODE	FSC 1N4148	CR11,22
DIODE	MOT 1N5240	CR1-10,12-21
TRANSISTOR MOS-FET N-CHANNEL 450V	ZTX ZVN0545A	Q1-10
CONNECTOR RECEPTACLE PIN	AMP 60888-3	

MODEL 244A RECOMMENDED SPARE PARTS

DESCRIPTION	VENDOR NO.	REF. NO.
LED RD	HPD HLMP-3301	CR201
LED GN	HPD HLMP-3507	CR202
IC, POS ADJ/500MA TO-202 VREG	NSC LM317MP	A18
▪ FUSE 1/4A SLO-BLO FOR 100 & 120V	LTF 313.250	F201,202
▪ FUSE 1/10 SLO-BLO FOR 220V	LTF 313.100	F201,202
PHOTOCOUPLER ME90912	MEI 90912	PC1,2
▪ 94803 DC-DC CONVERTER	MEI 94803	A15
BRIDGE	RCT DB104	CR27
DIODE	NSC LM329DZ	CR23,24
DIODE	MOT 1N4001	CR26
DIODE	FSC 1N4148	CR9,16-18,18A,19,20,20A, 21,22
DIODE	MOT 1N4744A	CR25
▪ DIODE	MOT 1N4750	CR8
DIODE	MOT 1N5234	CR13,13A,14,14A
DIODE MOV	GEC V33MA1B	CR6,7
DIODE	SGS 1N6263	CR11,12
DIODE	MOT 1N457	CR15
PHOTOCOUPLER	GEC H24B2	PC3
TRANSISTOR	MOT 2N4871	Q9
TRANSISTOR	NSC 2N6714	Q13,14
▪ TRANSISTOR	SLI J113-18	Q5
▪ TRANSISTOR	SLI J175	Q2
▪ TRANSISTOR	SLI J177-18	Q4
TRANSISTOR	SLI SD211DE	Q3
▪ TRANSISTOR	MOT MPS-A06	Q8
▪ TRANSISTOR	MOT MPS-A13	Q10
TRANSISTOR	MOT MPS-A56	Q11
TRANSISTOR	MOT MPS-A63	Q6
▪ TRANSISTOR	FEI ZTX653	Q12
IC, LIN 16486 GENERAL PURPOSE BIFET OP AMP	TXI TL082CP	A4
▪ IC, UNCOMP OP AMP	NSC LM301AN	A9,11
IC, SUPER GAIN OP AMP	NSC LM308N	A2,8
▪ IC, POS ADJ/500MA TO-202 VREG	NSC LM317MP	A16
IC, -12V/100MA TO-92 VREG	NSC LM320LZ-12	A14
▪ IC, QUAD OP AMP	NSC LM324N	A5
IC, +/-15V/100MA TO-5 VREG	NSC LM325H	A17
IC, +12V/100MA TO-92 VREG	NSC LM340LAZ-12	A13
▪ IC, QUAD 741 OP AMP	NSC LM348N	A6,7
IC, LO-PWR BIFET OP AMP (DUAL)	NSC LF442CN	A3
IC, PRECISION TIMER	NSC LM3905N	A12

DESCRIPTION	VENDOR NO.	REF. NO.
▪ IC, QUAD BILATERAL SWITCH	RCA CD4066BE	A10
LED YL	HPD HLMP-3401	CR1-4
IC	TLD TSC7211AIPL	A2
LCD DECODER DRIVER		
LCD METER	HAR 3918-365-020	A1
DIODE	FSC 1N4148	CR3,4
DIODE	FSC 1N457A	CR1,2
IC, +5.0V/250MA TO-202 VREG	NSC LM342P-5.0	A1
IC, QUAD XOR GATE	RCA CD4070BE	A2
▪ IC	ISI ICL71C03ACPI	A4
IC	ISI ICL8052ACPD	A3
PHOTOCOUPLER ME90912	MEI 90912	PC1,2
TRANSISTOR-FETME90060S SELECT WHITE DOT	MEI 90060S	Q13-22
DIODE HV	HVC G4FS	CR2-5
DIODE	FSC 1N4148	CR16,27,28,29
DIODE ZENER	MOT 1N5364B	CR1
DIODE	MOT 1N5240B	CR6-15,17-26
TRANSISTOR MOS-FET N-CHANNEL 450V	ZTX ZVN0545A	Q3-12
TRANSISTOR	FEI ZTX653	Q1,2
TRANSISTOR-FETME90060S SELECT WHITE DOT	MEI90060S	Q11-20
DIODE	FSC 1N4148	CR11,22
DIODE	MOT 1N5240	CR1-10,12-21
TRANSISTOR MOS-FET N-CHANNEL 450V	ZTX ZVN0545A	Q1-10

▪ As a percentage of failures, these components require replacement more often than other components.

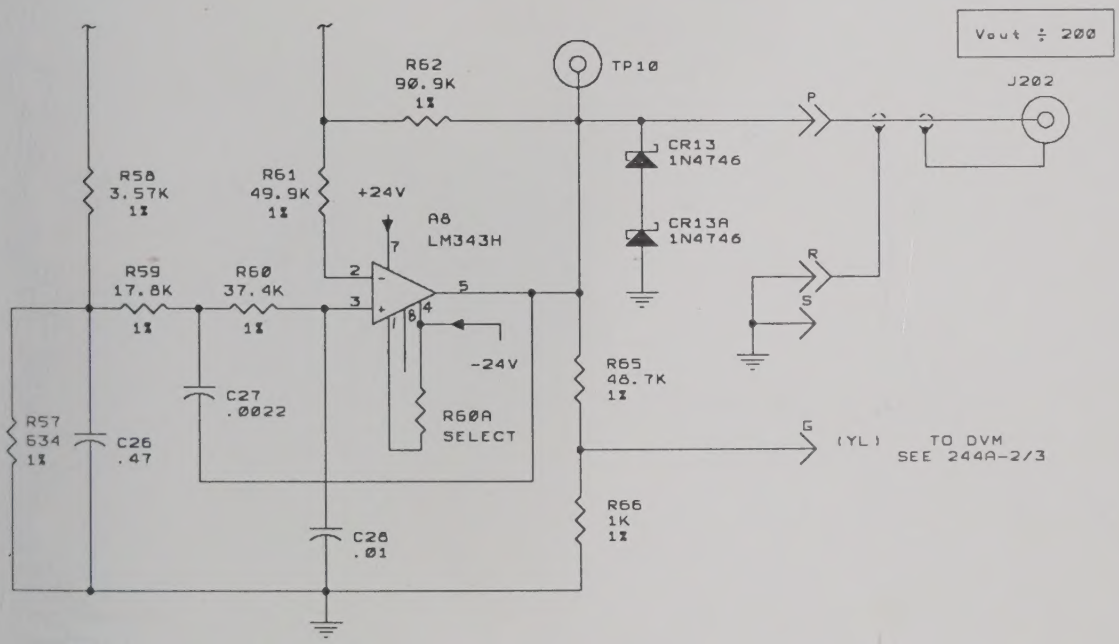
REVISION NOTES

MODEL 244AK

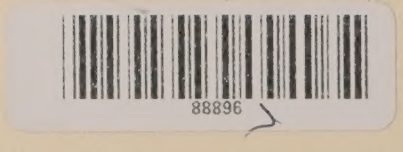
The Monroe Electronics Model 244AK is virtually identical to Model 244A except that:

The Recorder Output of Model 244AK is 1/200th of the ±3000 volt range of the instrument thus producing an output signal of up to ±15 volts capable of driving 5000 ohms or greater.

The above should be borne in mind when using this manual.



MODEL 244AK OUTPUT STAGE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